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ABSTRACT

This set of 33 skill sheets for agricultural mechanics was developed for use in high school and vocational school agricultural mechanics programs. Some sheets teach operational procedures while others are for simple projects. Each skill sheet covers a single topic and includes: (1) a diagram, (2) a step-by-step construction or operational procedure, (3) abilities and understandings taught, (4) materials needed, and (5) an evaluation score sheet. These skill sheets can be used in conjunction with the following instructional areas related to small engines and tractor power: metals (cold or hot), electric motors, carpentry, basic electricity, automatic controls, metal and concrete construction, oxy-acetylene and arc welding, and agricultural machinery. (Author/BP)

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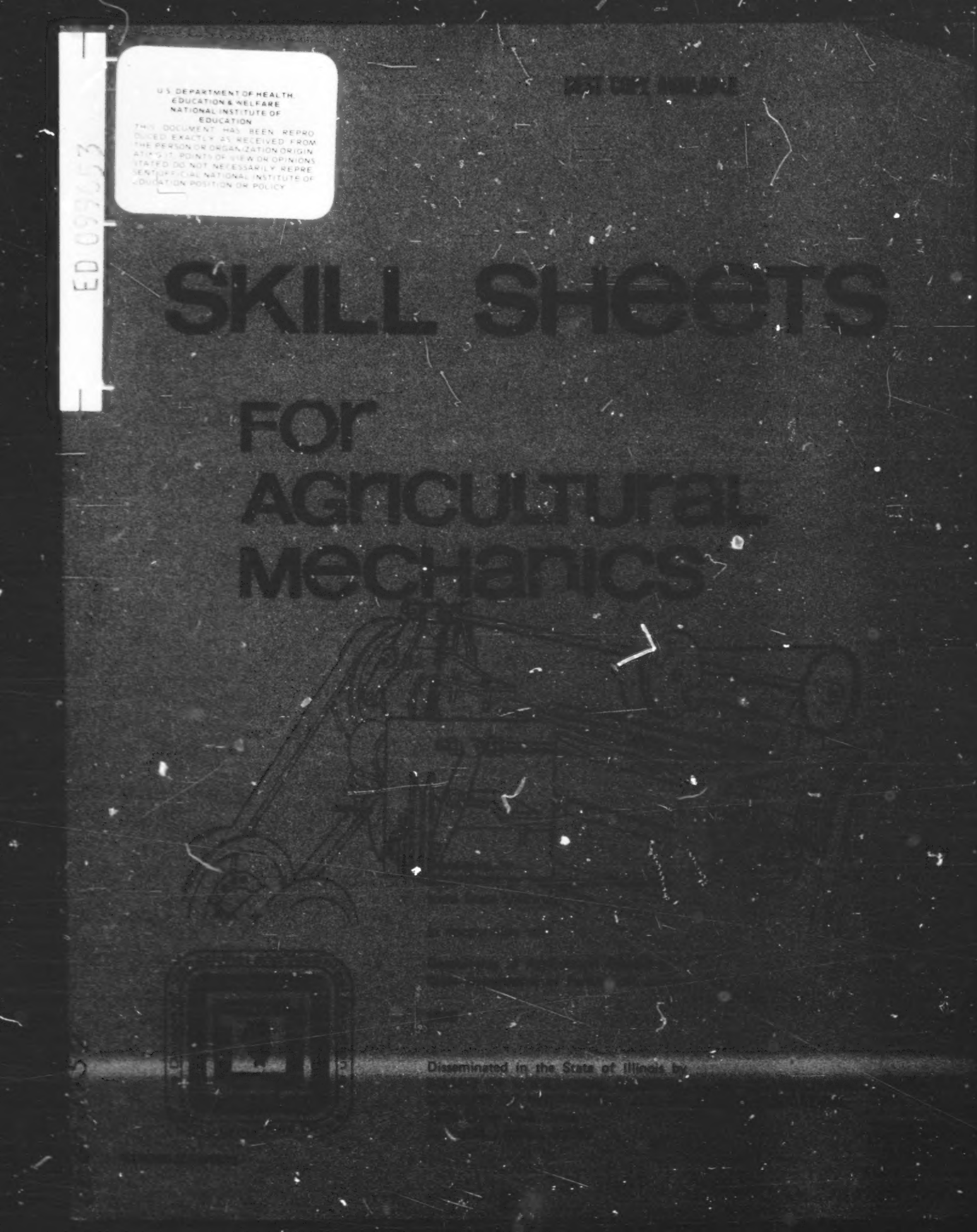
SKILL SHEETS

For AGRICULTURAL MECHANICS



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Additional copies of these "Skill Sheets for Agricultural Mechanics" at $2.00 each from Dr. Thomas A. Hoerner, Agricultural Engineering Department, Iowa State University, Ames, Iowa 50010. Checks are to be made payable to the Agricultural Engineering Department.

SKILL SHEETS FOR AGRICULTURAL MECHANICS

These skill sheets were developed for use in the high school and vocational school agricultural mechanics programs. Their main purpose is teaching specific skills or abilities related to agricultural mechanics. Individual skills should be taught before students are allowed to work on larger approved type projects requiring numerous skills. Many of the skills in this set can become part of the required activities phase of the agricultural mechanics program.

It is suggested that the skill sheets be used with the following instructional units.

	Skill Sheets	Units
1.	Reading the Micrometer	Small Engines & Tractor Power
2.	Sharpening the Twist Drill Bit	Metals
3.	Cleaning and Servicing an Electric Motor	Electric Motors
4.	Tool Sharpening Gauge	Metals
5.	Cleaning a Paint Brush	Carpentry
6.	Concrete Float	Carpentry
7.	Nail and Tool Carrier	Carpentry
8.	Sharpening a Wood Chisel	Carpentry
9.	Shoe Scraper with Concrete Base	Metal & Concrete
10.	Servicing the Spark Plug	Tractor Power & Small Engines
11.	Extension Cord	Basic Electricity
12.	Magneto Coil-Condenser Tester	Tractor Power & Small Engines
13.	Sharpening a Plane Iron	Carpentry
14.	Feed Scoop	Cold Metals
15.	Cold Chisel	Hot Metals
16.	Drawbar Hitch Pin	Metals & Arc Welding
17.	Sawhorse	Carpentry
18.	Wiring the Time Delay Reley	Automatic Controls
19.	Rafter Layout	Carpentry
20.	Use of the Torque Wrench	Tractors, Ag Machinery & Small Engine
21.	Photoelectric Control	Automatic Controls
22.	Making Quality Welds	Arc Welding
23.	Tool Sharpening Gage	Metals
24.	Drill Bit, Bolt & Washer Gauge	Metals
25.	Chipping Hammer	Metals

	Skill Sheets	Units
26.	Welded "C" Clamp	Metals & Arc Welding
27.	The Electric Motor Nameplate	Electric Motors
28.	Adjustable Safety Jack	Metals & Arc Welding
29.	Funnel	Metals
30.	Case Hardening of Mild Steel	Metals
31.	Oxy-Acetylene Welding Equipment	Oxy-Acetylene
32.	Braze Welding Mild Steel	Oxy-Acetylene
33.	The Arc Welding Molten Pool	Arc Welding

Each skill sheet consists of: (1) construction or operational procedures, (2) abilities and understandings taught, (3) a plan or drawing, (4) materials needed and (5) an evaluation score sheet.

The skill sheets included in this set were developed by Gary McVey, Herbert Hansen, Donald Ahrens, John Pothoven and Thomas A. Hoerner, Agricultural Engineering Staff members at Iowa State University.

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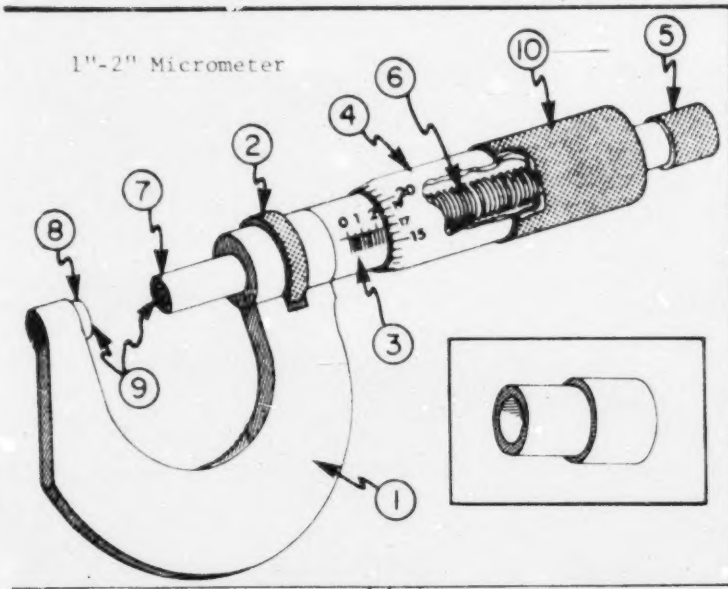
READING THE MICROMETER

1"-2" Micrometer



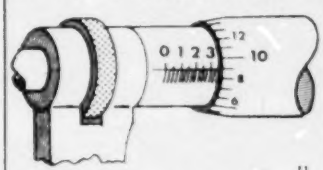
Part Identification:

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

Operational Procedure:

1. Complete the part identification section
2. Reading the micrometer:
   a. List the smaller number of inches that can be read with the micrometer illustrated to the left _____"
   b. Denote the number on the sleeve that the thimble edge just passed, this indicates the number of hundred thousandths _____"
   c. Count the number of full spaces that is between the last numbered line (Step b) and the thimble edge and multiply by .025 _____"
   d. Locate the line on the thimble that matches the horizontal line on the sleeve and list this number in thousandths _____"
   e. Total the valves (a+b+c+d) _____"
3. Determining the measurements of the two-step machined, practice cylinder:
   a. Using a 1" - 2" micrometer list the measurement of the top step in thousandths. Proper measurement should be the average of measurements made at 3 points around the cylinder _____'
   b. Determine the measurement of the lower step _____'
   c. Subtract the reading in Step (b) from reading in Step (a) to determine the difference in thousandths of an inch _____'
4. Determine the readings of the micrometers shown below:

A. 0"-1" Micrometer



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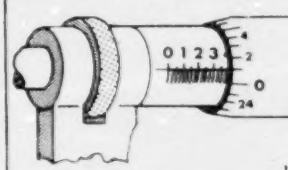
B. 2"-3" Micrometer



_____'

(Ability to .....
Operation Teaches: (Understanding of .....

1. A. Identify the parts of the micrometer
2. U. The function of the various parts
3. U. The use of decimals and fractions in measurements
4. A. Convert fractions to decimals and decimals to fractions
5. A. Properly hold the micrometer
6. A. Feel a reading
7. A. Read the micrometer to the nearest one thousandths of an inch
8. A. Use the micrometer to measure flat, round or square stock

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Micrometer part identification (2 points per correct item)	20	
2. Reading the micrometer	25	
3. Determining the difference in the measurements of the practice cylinder (3-c) (plus or minus .001" = 30 pts., + or - .002" = 20 pts., + or - .003" = 10 pts., greater than .004" off correct reading = 0 pts.)	30	
4. Determining the reading of the micrometer inserts (5 pts. each)	10	
5. Handling the micrometer	10	
6. Attitude and work habits	5	
Total	100	

Materials:

1 - 1" - 2" micrometer
1 - two-step practice cylinder (top step between 1.75" and 2.00" lower step 1.25" to 1.75")

Name: _____

Date: _____ Grade: _____

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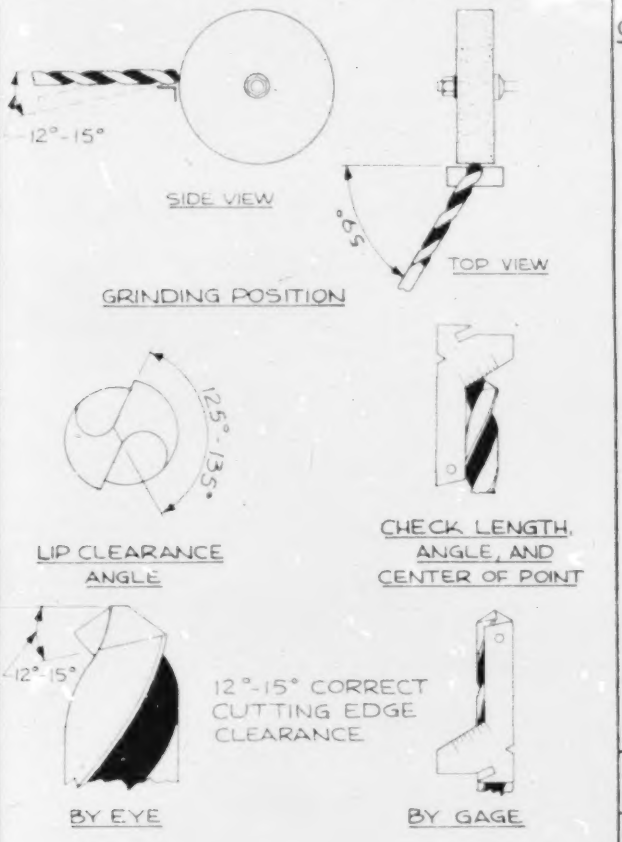
SHARPENING THE TWIST DRILL BIT



Material: 1 - Dull drill bit 3/8"-1/2"

Operation Teaches (Ability to ..... (Understanding of ....

1. U. Correct grinding wheel for sharpening drill bits.
2. A. Dress a grinding wheel
3. U. Drill bit types and sizes
4. U. Measurements to check when sharpening a drill bit
5. A. Make measurements on drill bit with tool gauge
6. A. Hold drill bit at 59° to grinding wheel face
7. A. Sharpen drill bit to attain chisel edge angle, 120-135° and 12-15° lip clearance
8. A. Secure bit in drill press chuck
9. A. Layout and center punch metal
10. A. Secure metal in drill press vise
11. A. Bore hole in mild steel

Operational Procedures:

1. Dress grinding wheel with dressing tool
2. Hold drill bit against face of wheel at 59° angle on cutting lip
3. Carry drill bit up the wheel face by dropping end and rotating very slightly in clockwise direction
4. Make slow deliberate strokes, the full width of the cutting lip
5. Do not lower cutting lip below the horizontal position as this will round the cutting edge
6. When one lip is ground, rotate the drill one-half turn and grind the other lip
7. Use tool gauge to check equal lengths of lips, 59° angle cutting lip and 12-15° lip clearance
8. Test bit by boring hole in mild steel plate
9. Stop while drilling, turn drill press in reverse direction to release drill bit from hole. Note depth of cut of each lip
10. Make grinding corrections on drill bit as indicated by hole
11. Submit drill bit and metal for evaluation

Evaluation Score Sheet

Item	Points Possible	Points Earned
1. Cutting lip angle 59°	20	
2. Cutting lips equal length	15	
3. Lip clearance 12-15°	15	
4. Correct angle between dead center and cutting lip, chisel edge angle, 120-135°	10	
5. Smoothness of grinding surface, lip to heel	5	
6. Bit cuts spiral chips	10	
7. Hole drilled is correct size	10	
8. Work habits and attitude	15	
Total points		

Name: _____

Date: _____ Grade: _____

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CLEANING AND SERVICING AN ELECTRIC MOTOR

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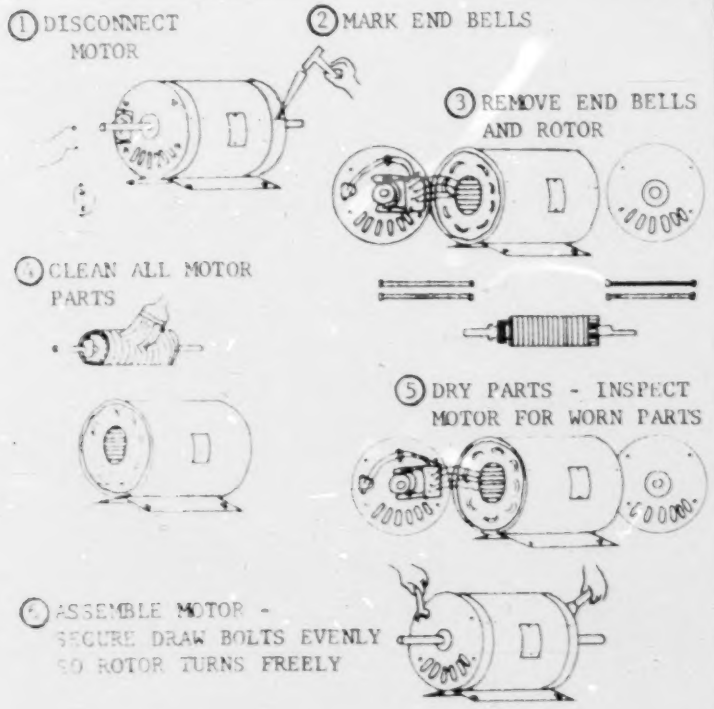
1 DISCONNECT MOTOR
2 MARK END BELLS
3 REMOVE END BELLS AND ROTOR
4 CLEAN ALL MOTOR PARTS
5 DRY PARTS - INSPECT MOTOR FOR WORN PARTS
6 ASSEMBLE MOTOR - SECURE DRAW BOLTS EVENLY SO ROTOR TURNS FREELY

Materials

1. An electric motor needing to be cleaned and serviced
2. Tools for disassembling an electric motor
3. A paint brush, motor cleaning solvent and pan to wash parts

Operation Teaches (Ability to . . . (Understanding of . . .

1. A. disconnect a motor from an electrical source
2. A. correctly mark motor frame and end bell
3. U. importance of carefully removing the en bells so as to not damage leads or moto windings
4. A. remove rotor from motor without damagin the centrifugal switch or motor brushes
5. U. correct type solvent to use in cleaning an electric motor
6. A. thoroughly clean and dry all motor part
7. A. identify and inspect parts for wear or damage
8. A. reassemble motor parts in reverse order of disassembly and tighten end bell bol
9. A. lubricate motor using correct type and amount of lubrication
10. A. connect motor to power source

Operational Procedure

1. Disconnect motor leads at terminal cover plate. Note position of leads on terminals
2. Remove motor from mount or machine
3. Wipe all dirt from outside of motor
4. Mark end bells with center punch-one mark on end bell and stator frame on terminal connection end. Use 2 marks on other end
5. Remove end bell bolts
6. Using a wood block or soft-faced hammer remove end bell containing starting switch or brush ring
7. Remove rotor and other end bell
8. Clean all motor parts with motor solvent. Do not use gasoline. Use carbon tetrachloride only in a well ventilated area. Avoid soaking the windings or leads
9. Dry all parts with a cloth or compressed air
10. Identify and examine all parts for wear, damage or loose connections-make necessary repairs
11. Reassemble motor in reverse to disassembly. Tighten end bell bolts evenly checking to see that the rotor turns freely
12. Lubricate motor bearings with #10 oil or grease depending upon type
13. Mount motor and connect electrical leads-try motor by throwing switch

Evaluation Score Sheet

Item	Points Possible	Points Earned
1. Correctly disconnecting motor from electrical source-mark leads	5	
2. Correctly marking end bells	5	
3. Carefully removing end bells in correct order	10	
4. Selecting correct solvent for cleaning motor	5	
5. Thorough cleaning and drying of motor parts	15	
6. Inspection and identification of parts-make repairs	20	
7. Correct reassembling of motor, rotor free to turn	10	
8. Proper type and amount of lubrication used on motor	10	
9. Connecting motor to power source-motor runs properly	10	
10. Work habits and attitude	15	
Total points	100	

Name _____

Date _____ Grade _____

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TOOL SHARPENING GAUGE

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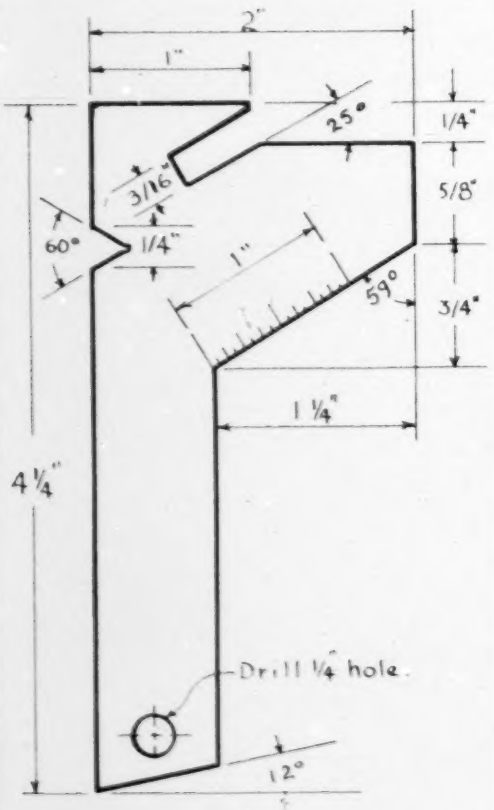

Gauges

A) Plane iron or wood chisel
B) Cold chisel or center punch
C) Twist drill, cutting edge angle and length
D) Twist drill, lip clearance

Bill of Material

1 - 2 1/4 x 4 1/2 - 3/32" stainless steel, mild steel, brass or 1/8" aluminum

Name: _____

Date: _____

Grade: _____

Constructure Procedure:

1. Measure and scribe outline on stock with awl
2. Cut out tool gauge with hacksaw
3. Use flat file to cut wood chisel slot
4. Use taper file to cut cold chisel vee
5. Position and drill 1/4" hole at narrow end of gauge
6. Measure and scribe a 1" rule by 1/16" graduations
7. Cut rule indicator marks with cold chisel
8. Polish for final finish

(Ability to _____

Construction Teaches (Understanding of _____

1. U. selection of the flat stock
2. A. measure and transfer outline of gauge to stock
3. A. scribe outline on metal with awl
4. U. the correct hacksaw blade to select for cutting sto
5. A. to use the hacksaw
6. U. the correct files to select for filing slot and vee
7. A. cut the slot with the flat file
8. A. cut a vee with the taper file
9. U. the need for center punching before drilling
10. A. use of the center punch
11. U. fastening metal before drilling
12. A. adjust speed and use of the drill press
13. A. calibrate and indicate rule marks on metal
14. A. set rule marks in metal with the cold chisel
15. U. correct grinding wheels and setting of tool rest
16. U. correct method of finishing & polishing flat stock
17. A. use abrasive wheel and emery cloth to polish gaug

Evaluation Score Sheet:

Item	Points Possible	Ear
1. Length of gauge	5	
2. Width of narrow end	5	
3. Width of wide end	5	
4. Angle of wood chisel slot	15	
5. Vee position for cold chisel angle	15	
6. Angle for drill cutting edge	15	
7. Accuracy of the 1" rules	10	
8. Angle for drill lip clearance	10	
9. Hole centered	5	
10. Finish	5	
11. Attitude and work habits	10	
Total Points		

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CLEANING A PAINT BRUSH

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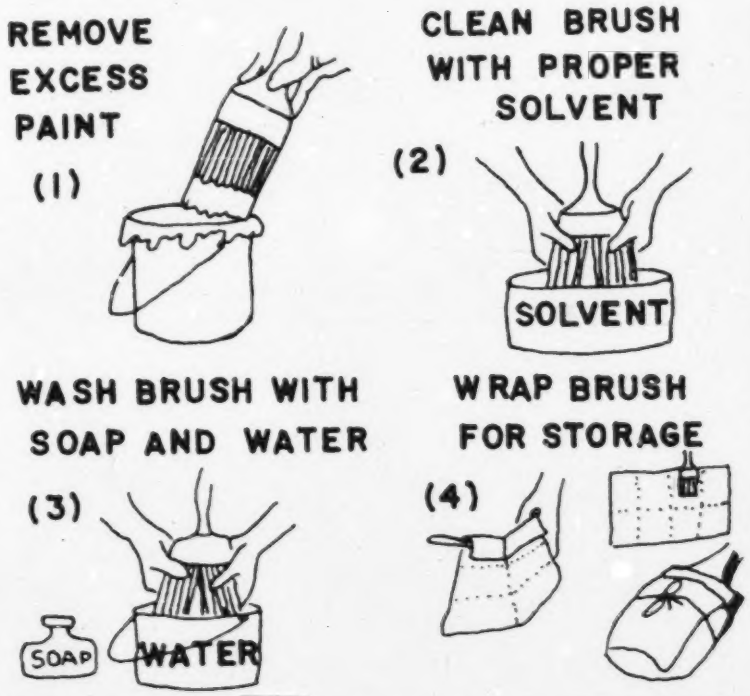

Materials:

1. Used paint brush in need of
2. Bucket or can for cleaning
3. Solvent
4. Detergent
5. Wrapping paper and string

(Ability to .

Operation Teaches (Understand

1. U. types of paint brushes
2. U. the importance of using a brush when painting
3. A. to select and use the cor solvent
4. A. to remove all paint from bristles of brush in clea
5. U. the safe use of cleaning
6. A. to remove solvent from with soap and water
7. U. the proper method to sto
8. A. to wrap a brush properly storage

Operational Procedure:

1. Select proper solvent:
   a. oil base - gum turpentine
   b. lacquer - lacquer thinner
   c. shellac - wood alcohol
   d. water base - water
2. Remove excess paint from brush by scraping on edge of can
3. Properly seal paint can lid
4. Place brush in container of proper solvent
5. Work solvent briskly (usually with fingers) into the bristles of the brush
6. When all paint is removed from brush, drain excess solvent from the brush
7. Wash remaining solvent from brush using soap and water
8. Dry excess water from brush with paper towel
9. Secure a piece of wrapping paper about 5 times as long as the brush is wide
10. Place bristles of brush toward center of paper about one brush width from edge of paper
11. Fold opposite edge of paper over bristles and wrap brush for storage, tying with string
12. Observe all safety rules and precautions in working with solvents

Evaluation Score Sheet

Item	Poss
1. Selecting of proper solvent	
2. Removal of excess paint using lip of can	
3. Properly seal paint can	
4. Working solvent into bristles	
5. Draining solvent from brush	
6. Removing solvent with soap and water	
7. Properly drying brush	
8. Wrapping brush in paper	
9. Safety in using solvents	
10. Work habits and attitude	

Total Points

Name _____

Date _____ Grade

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TAH 668

CONCRETE FLOAT

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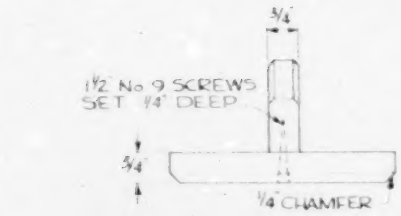

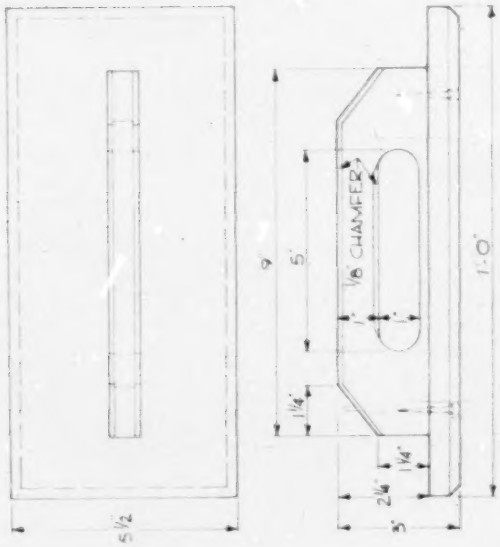

Construction Procedure:

1. Lay out and cut base to dimension
2. Chamfer base edges
3. Lay out and cut outside dimensions of handle
4. Drill and cut hole in handle
5. Chamfer edges of handle
6. Locate handle, drill pilot holes for screws
7. Fasten handle to board with glue and No. 9 wood screws
8. Sand float, apply one coat of linseed

Construction Teaches	(Ability to..... (Understanding of...
1.	A. Measure accurately
2.	A. Use the table, radial arm or hand
3.	U. Principles of jointer operation
4.	A. Properly use the jointer
5.	A. Drill holes in wood
6.	A. Use the saber saw
7.	A. Use a wood chisel
8.	U. Correct wood auger bit sizes
9.	A. Drill pilot holes for screws
10.	A. Drive screws
11.	A. Use the 1/4" drill
12.	A. Finish and treat with linseed oil

Bill of Materials

1 - 1" x 6" x 1' white pine board
1 - 1" x 3" x 9" white pine board
2 - 1-1/2" #9 FH bright wood screws
1/4 pint linseed oil

Name_____

Date_____

Grade_____

Evaluation Score Sheet:

	Item	Poi Possible
1.	Correct length and width of base	15
2.	Base of square	10
3.	Chamfers smooth, even, correct dimensions	10
4.	Correct handle dimensions	15
5.	Hole in handle is smooth	10
6.	Handle centered on base	10
7.	Screws properly countersunk	10
8.	General appearance	10
9.	Work habits and attitude	10
	Total Points	100

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NAIL AND TOOL CARRIER

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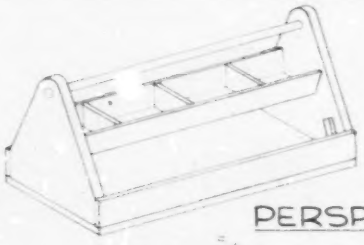

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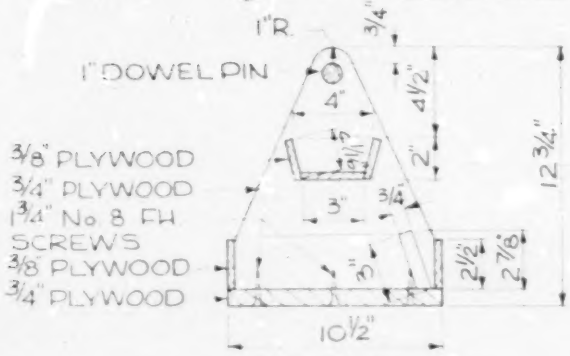

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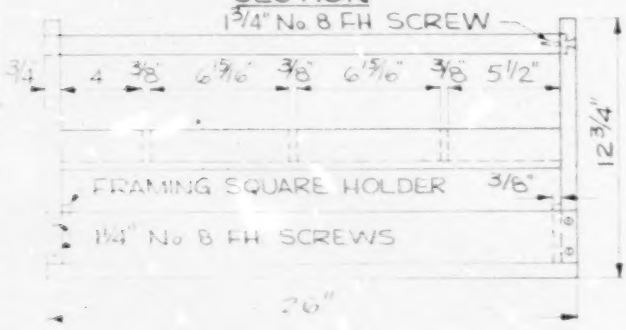

Bill of Material

2 - 3/4" x 9-3/4" ends
1 - 3/4" x 10-1/2" x 26" bottom
2 - 3/8" x 2-1/2" x 26" sides
1 - 3/8" x 3" x 24-1/2" tray bottom
2 - 3/8" x 2-1/16" x 24-1/2" tray sides
1 - 3/8" x 2" x 11" tray partition
1 - 1" x 26" dowel pin
2 - 3/8" x 3/4" x 3" framing square holder
8 - 1-1/2" #8 F.H. wood screws (sides)
6 - 1-3/4" #8 F.F. wood screws (ends)
Exterior plywood or pine boards as desired
Waterproof or water resistant glue

Name_____

Date_____ Grade_____

Construction Procedure:

1. Lay out material from cu
2. Cut parts to dimension
3. Bevel bottom of tray
4. Bore holes for handle in
5. Assemble to check dimens
6. Prebore screw holes
7. Disassemble and mix glue
8. Apply glue, assemble wit screws
9. Clean excess glue from
10. Allow glue to set
11. Sand and finish joints
12. Paint

(Abili

Construction Teaches: (Under

1. A. Read a plan and prep list.
2. A. Measure and mark dis
3. U. Correct saw and saw
4. A. Saw boards to dimens
5. A. Use a saber, jig or
6. A. Use brace and bit or and bit.
7. U. Correct nail and scr
8. U. Correct wood adhesiv
9. A. Glue, nail and drive assembly.
10. U. Correct sanding meth
11. A. Sand and finish wood
12. U. Paint types.
13. A. Apply paint, clean brushes.

Evaluation Score Sheet:

	Item
1.	Correct dimensions
	length
	width
	height
	handle placement
	tray location
2.	Square corners & joints
3.	Edges square and smooth
4.	Placement of nails & screws
5.	Finish and painting
6.	Overall appearance
7.	Attitude & work habits

Total Points

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SHARPENING A WOOD CHISEL

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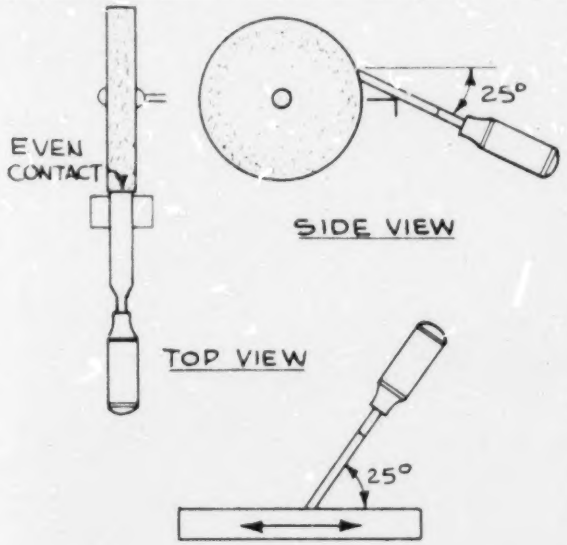

Operational Procedure:

1. Select correct grinding wheel for tool sharpening, dress grinding wheel
2. Place the wood chisel between the left forefinger and the thumb, and the forefinger against the outside edge of the tool rest
3. Push the chisel forward between the forefinger and thumb of the left hand until it is at the proper angle with the grinding wheel
4. Make sure the grinding stone is turning down toward the chisel
5. Hold the chisel firmly in the left hand and slide the left forefinger from left to right along the tool rest for a guide until the entire width of the edge has been ground almost to a wire edge
6. At the same time use the right hand to apply pressure and help guide the chisel
7. To keep the cutting edge square with the sides, stop the strokes when the back edge of the chisel passes beyond the edge of the grinding wheel about one-third of the width of the wheel
8. Check the bevel with the tool gauge frequently during the grinding to see that it is being ground to a 25 degree angle
9. Hold the chisel against the whetstone moving it back and forth, making sure the heel and toe of the hollow ground bevel are touching the stone
10. Add oil to whetstone as needed
11. Continue whetting until a sharp edge is obtained
12. Remove the wire edge by turning the chisel over and taking a few strikes with the chisel flat against the stone

Materials: Grinding Wheel
Dull Chisel
Whetstone and No. 10 Oil

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. One ground face, concave	15	
2. Even width of bevel	10	
3. Correct angle	10	
4. Cutting edge square to shank	10	
5. Uniform whetting face	15	
6. Wire edge removed	10	
7. Sharp cutting edge	25	
8. Work habits and attitude	5	
Total Points	100	

Operation Teaches: (Ability to .....
(Understanding of .....

1. U. When to sharpen the chisel
2. U. The proper angle of the bevel
3. U. Correct grinding wheel for sharpening
4. A. Properly dress the grinding wheel
5. A. Properly sharpen the chisel
6. U. Results of excess pressure when grinding
7. U. Tempering of tool steel
8. U. Selection and purpose of the whetstone
9. A. Use the whetstone
10. A. Remove the wire edge using the whetstone

Name: _____

Date: _____ Grade: _____

DEPARTMENT OF AGRICULTURAL ENGINEERING

IOWA STATE UNIVERSITY

TAH 968

SHOE SCRAPER WITH CONCRETE BASE

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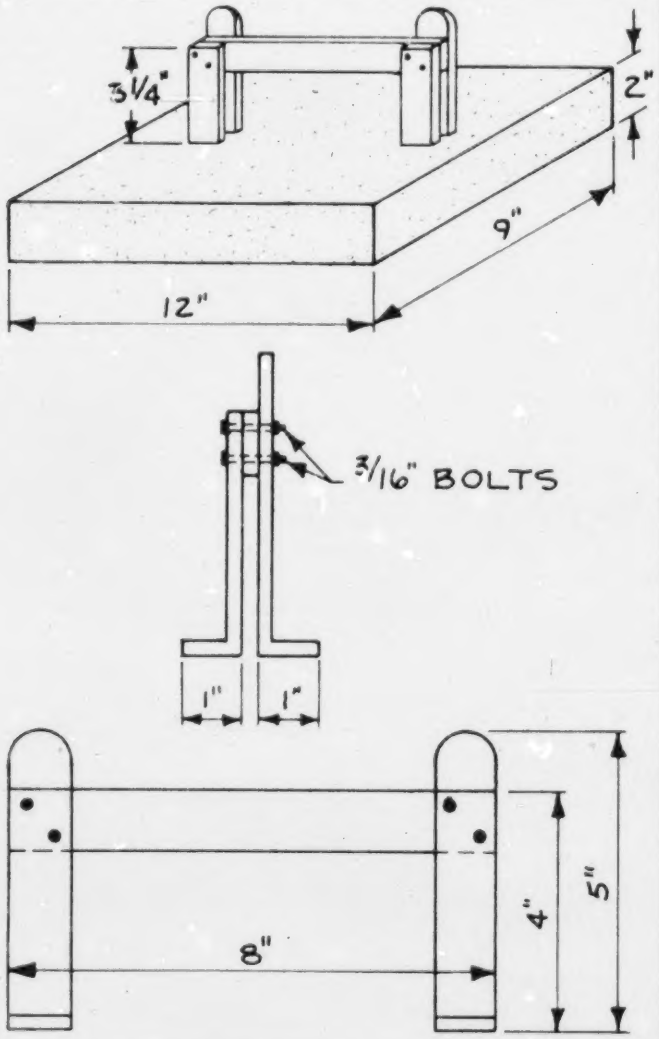

Construction Procedure:

1. Measure and cut metal pieces
2. Bend each leg square, use heat and vise
3. Round the top of each 6" leg by grinding
4. Mark and center punch for holes
5. Drill holes in legs and center piece for 3/16" bolts
6. Bolt legs and center piece together, cut off excess bolt and rivet the end
7. Construct form for the concrete base from 1" x 2" and 1/2" plywood material
8. Oil form with paraffin base or #10 oil
9. Mix concrete and place about 3/4" in the form
10. Place metal scraper in the center and fill form with concrete
11. Spade concrete around the eges and trowel surface
12. Remove form, set concrete base in water 3-7 days
13. Paint metal parts of scraper

Bill of Material:

1 - 1/4" x 1" x 30" mild steel strap
4 - 3/16" x 1" R.H. stove bolts
1-1/4 quarts cement, 2-1/2 quarts sand, 2-1/2 quarts crushed stone, one quart water
1 - 10-1/2" x 13-1/2" x 1/2" exterior plywood for form base
1 - 1" x 2" x 44" white pine, form lumber

Name: _____

Date: _____

Grade: _____

Construction Teaches:	(Ability to . . . . . (Understanding of . . .
1. U.	Mild steel classification and standard shapes
2. A.	Measure and transfer plans to work
3. U.	The correct hacksaw blade to use
4. A.	Use the hacksaw
5. U.	Drill bit sizes
6. A.	Use the drill press
7. U.	Bolts, types and sizes
8. A.	Heat and bend metal
9. U.	Selection of wood for concrete forms
10. A.	Construct concrete forms
11. U.	Materials for mixing quality concrete
12. A.	To mix, cast and cure concrete
13. A.	To select and paint metal parts of scraper

Evaluation Score Sheet:

		Points Possible	Points Earned
1.	Dimensions of metal unit	25	
2.	Dimensions and squareness of concrete form	20	
3.	Location of scraper in base	15	
4.	Concrete finish and curing	20	
5.	Overall appearance	10	
6.	Attitude and work habits	10	
	Total Points	100	

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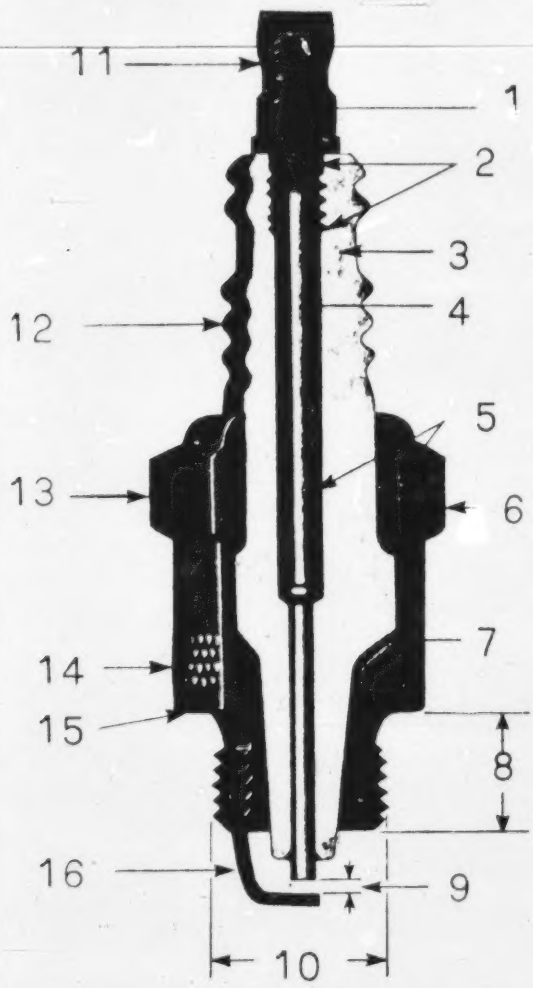
SERVICING THE SPARK PLUG



Part Identification:

1. _____ 9. _____
2. _____ 10. _____
3. _____ 11. _____
4. _____ 12. _____
5. _____ 13. _____
6. _____ 14. _____
7. _____ 15. _____
8. _____ 16. _____

Operational Procedure:

1. Identify parts of the spark plug
2. Remove plug after cleaning plug-well
3. Remove oily deposits from plugs with cleaning solvent
4. Check condition of the porcelain (good - fair - poor)
5. Remove carbon deposits from plugs
6. Blow away all foreign matter
7. File electrodes until surfaces are flat
8. Determine plug type, (hot - normal - cold)
9. Determine proper spark gap _____"
10. Regap plug using correct gauge
11. Check plug reach
12. Check plug gasket condition (good - fair - poor)
13. Determine proper torque: in. lbs.____, ft. lbs.____
14. Tighten plug with torque wrench to recommended torque

Materials: Fouled plugs, gauges, files, wire brushes, & cleaning solvent.
FACTS ABOUT SPARK PLUGS & ENGINES, Champion Spark Plug

Operation teaches: (Ability to ... (Understanding of...

1. U How a spark plug functions
2. U The parts of the spark plug
3. A Recognize fouled plug
4. A Clean the plug
5. A File the electrodes
6. A Properly gap the spark plug
7. A Use the wire gap gauge
8. A Use the torque wrench
9. A Recognize a bad plug gasket
10. U Hot and cold type plugs

Evaluation Score Sheet:

		Points Possible	Earned
1.	Parts of plug properly identified	16	_____
2.	Oil removed and threads cleaned	4	_____
3.	Condition of porcelain	5	_____
4.	Carbon deposits removed	10	_____
5.	Electrodes properly filed	10	_____
6.	Spark plug heat range	5	_____
7.	Correct gauge for gapping used	10	_____
8.	Plugs properly gapped	15	_____
9.	Proper reach used	5	_____
10.	Gasket condition	5	_____
11.	Determining torque for plug	5	_____
12.	Plug correctly torqued in engine	10	_____
	Total	100	_____

Job sheet prepared in cooperation with Randy Rumery and Dean Bartelt

Name _____

Date _____ Grade____

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EXTENSION CORD

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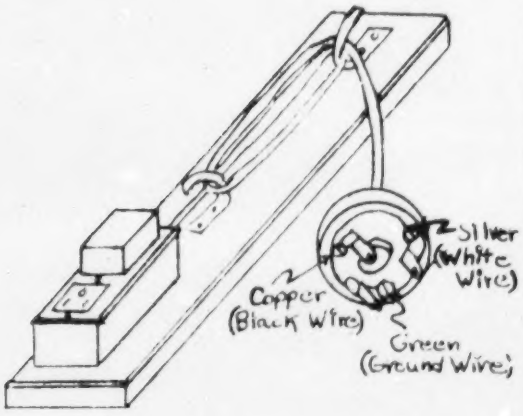

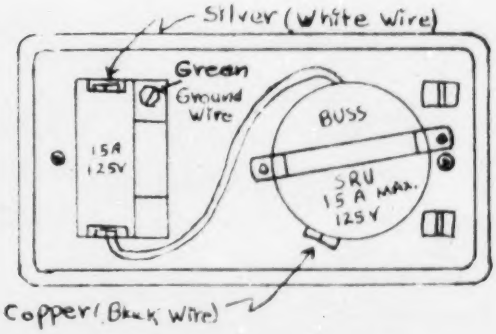

Construction Procedure:

1. Determine length of cord holder. Suggest 1 x 4 x 18"
2. Bevel 4 edges of board
3. Shape brackets to hold electrical conductor
4. Locate electrical box on mounting board
5. Attach electrical box to board using 4, 3/4" No. 8 screws
6. Cut 10 - 16 feet of 16-3 SJ rubber covered conductor with ground for cord
7. Wire grounded, fused receptacle as shown in drawing
8. Place receptacle in box, add cover plate and tighten box connector
9. Locate and attach brackets to board
10. Connect grounded cap (male plug)
11. Paint extension cord holder and box
12. Insert fusetron, assume 8 amp load _____fusetron size.

Bill of Material

1 Pine board 1 x 4 x 18"
2 Mounting brackets, 1/8 x 1/2" x 5" mild steel
1 2" x 4" Handy box, 1-1/2" deep
1 Fused, grounded receptacle (SRU)
1 Fusetron fuse 7-1/2 - 10 amp range
1 Grounded cap (male plug)

1 3/4" Box connector
8 3/4" No. 8 Round Head Wood Screws
10' - 16' Rubber covered type S or SJ, 16 - 3 stranded conductor with ground

(Ability to.....)
Construction Teaches: (Understanding of .....)

1.	A	Shape mounting board
2.	A	Use metal shears, drill press and drills
3.	U	Selection of electrical conductors and caps
4.	U	Grounded, fused receptacles
5.	U	120 and 240 volt circuits
6.	A	Properly wire fused receptacle
7.	U	Proper grounding of extension cords
8.	U	Types and sizes of fuses for specific applications
9.	A	Select correct type and size of fusing element
10.	A	Attach grounded cap to extension cord
11.	A	Paint extension cord holder

Name_____

Date_____Grade_____

Evaluation Score Sheet:

	Item	Points Possible	Points Earned
1.	Correct measurements	10	
2.	Mounting brackets	5	
3.	Attachment of brackets and box	10	
4.	Fused, grounded receptacle properly connected	25	
5.	Connection of grounded cap	15	
6.	Selection of correct fusing element	15	
7.	Quality of finish, painting	10	
8.	Attitude and work habits	10	
	Total Points	100	

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MAGNETO COIL-CONDENSER TESTER

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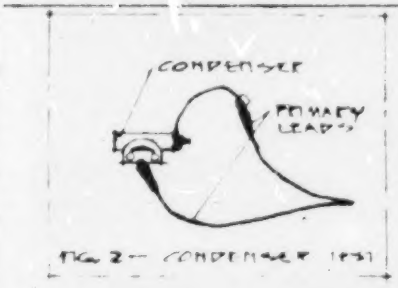

FIG 2 — CONDENSER TEST

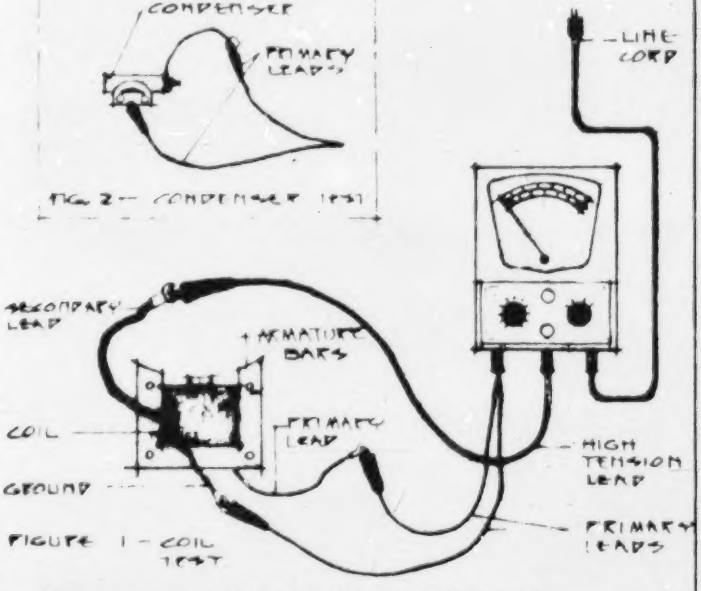

FIGURE 1 - COIL TEST

COIL - - CONDENSER TEST

Materials:

1. Coil-condenser tester, King Model 603, or equiv.
2. Small engine with coil and condenser
3. Coils and condensers of known quality or capacity
4. References to determine manufacturer's specifications for coils and condensers to be tested

Operation Teaches (Ability to . . .
(Understanding of . . .

1. U. basic function of the coil and condenser in the electrical system
2. A. detect damage to coil or condenser
3. A. properly connect tester for coil test
4. U. proper coil setting to test coil
5. A. read scale on tester and evaluate quality or condition of coil
6. A. properly connect tester for condenser test
7. U. condenser capacities in microfarads
8. A. read scale on tester and evaluate quality or condition of coil
9. A. test condenser for leakage
10. A. properly replace and connect coil and condenser in engine electrical system

NAME _____

DATE _____ Grade _____

Operational Procedure:

1. Remove coil and condenser from engine or di connect all leads except ground
2. Inspect coil and condenser for physical dam age and loose connections
3. Connect coil-condenser tester to power
4. Coil testing - Determine type and number of coil. Connect to coil as shown in Fig. 1
5. Adjust COIL SET to calibration index using good coil or according to coil set by manufacturer's. Coil Set_____
6. Place SELECTOR in COIL position
7. Read meter on coil or upper scale. If coil is good a minimum meter reading of 5 must b obtained. Meter reading_____
   Coil evaluation (good - fair - poor)
8. Move switch to OFF, disconnect leads.
9. Condenser Testing - Determine type and numb of condenser. Manufacturer's specification for capacity limits, MFD_____
10. Connect tester primary leads to condenser a shown in Figure 2.
11. Move switch to MFD position
12. Read meter on MFD. Reading in MFD_____
13. A full scale reading indicates a shorted or leaking condenser, a zero reading indicates an open condenser.
14. Place selector on TEST for leakage test. A good condenser will take an initial charge noted by a single flash in the neon lamp. Leaky condensers will be noted by a continu glow or flashing on or off.
15. Move switch to OFF, disconnect leads.
16. Condenser evaluation (good - fair - poor)
17. Reconnect coil and condenser, if needed replace with new coil or condenser
18. Request instructor evaluation

Evaluation Score Sheet:	Points Possible	Ear
1. Tester correctly connected for coil test	15	
2. COIL SET properly calibrated according to manufacturer	5	
3. Coil meter reading accurate (±1 division)	10	
4. Accurate evaluation of condition of coil	15	
5. Tester correctly connected for condenser test	15	
6. Manufacturer's specifications for condenser capacity	5	
7. MFD meter reading accurate	10	
8. Test for condenser leakage	10	
9. Accurate evaluation of condition of condenser	15	
TOTAL	100	

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TAH 1368

SHARPENING A PLANE IRON

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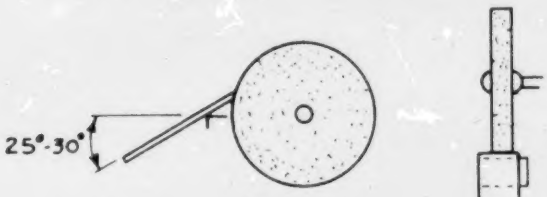
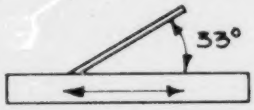


SIDE VIEW

TOP VIEW



WHETTING POSITION

REMOVING WIRE EDGE

Operational Procedures:

1. Dress the grinding wheel, remove plane iron from hand plane
2. Hold the plane iron against the face of the grinding wheel at a 25^{o} - 30^{o} angle
3. Move the plane iron from side to side to obtain an evenly ground edge
4. Dip plane iron in water to prevent overheating and loss of temper
5. Grind until all nicks are removed and a bevel twice the thickness of the plane iron is obtained
6. Hold the plane iron to the whetstone with toe and heel in contact
7. Move the plane iron back and forth against the whetstone
8. Add oil to the whetstone as needed
9. Continue whetting until a sharp edge is obtained
10. Remove the wire edge by turning the plane iron over and taking a few strokes with the plane iron flat against the stone using a side-ways motion
11. Replace plane iron in plane, test sharpness by edge planing of pine or other softwood
12. Present plane with plane iron installed to instructor for evaluation

Materials:

1. Plane iron in need of sharpening
2. Grinder with a tool rest and proper wheel
3. Whetstone and oil

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Bevel has one face	15	
2. Bevel twice the thickness of the plane iron	10	
3. Cutting edge is square to side	10	
4. All nicks removed	10	
5. Whetting bevel is even	10	
6. Wire edge removed	10	
7. Sharp cutting edge	15	
8. Plane iron properly installed in hand plane	10	
9. Work habits & attitude	10	
Total Points	100	

(Ability to . . . . . .
Operation Teaches: (Understanding of . . . . .

1. U. Proper grinding wheel for sharpening plane irons
2. A. Dress a grinding wheel
3. U. Measurements to check when sharpening a plane iron
4. A. Hold plane iron to grinding wheel face at correct angle
5. U. Whetstone selection and purposes
6. U. Importance of using oil on the whetston
7. A. Use a whetstone properly
8. A. Remove a wire edge
9. A. Hold plane iron to the whetstone at correct angle
10. A. Properly replace plane iron in hand plane

Name: _____

Date: _____

Grade: _____

DEPARTMENT OF AGRICULTURAL ENGINEERING
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FEED SCOOP

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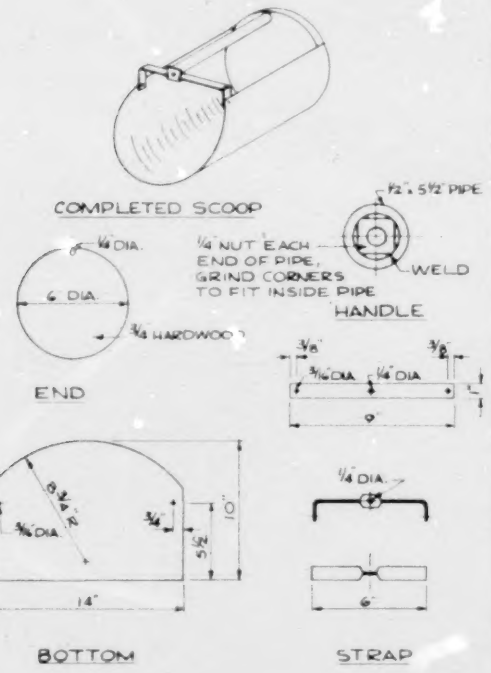

Construction Procedure:

1. Lay out and cut sheet metal and wood end
2. Cut and bore holes in strap iron, 1/8" x 1" x 9"
3. Cut light steel tubing, 1/2" x 5-1/2" for handle (Note a 3/4" dowell rod may be used instead of steel tubing)
4. Bend bottom sheet metal to fit end
5. Drill holes for screws and handle bolt
6. Screw metal to wood end
7. Heat and bend iron strap
8. Rivet on iron strap
9. Weld nuts in ends of tubing
10. Attach handle with 1/4" x 6-1/2" bolt
11. Finish and paint handle, bracket and wood end

Bill of Materials

1 - 10" x 14", 22 or 24 gauge galvanized sheet metal
1 - 3/4" x 6" x 6" hardwood board
1 - 1/8" x 1" x 9" hot rolled mild steel
1 - 1/2" x 5-1/2" light steel tubing
1 - 1/4" x 6-1/2" bolt
2 - 1/4" nuts
2 - 3/16" rivets
6 - 3/4" #6 blued R.H. screws
½ - pint paint for end, handle and hand bracket

(Ability to.....)
(Understanding of.....)

Construction Teaches:

1.	U.	The difference between sheet metal gauges and sizes
2.	A.	To layout, cut, and bend sheet metal
3.	A.	To cut strap iron
4.	U.	The length of strap needed for a bend
5.	U.	Process for bending hot metal
6.	A.	To bend and shape hot metal
7.	A.	To cut steel tubing
8.	U.	Hardwood and softwood
9.	A.	Bore hole in wood end
10.	U.	Bolt types
11.	U.	Types and uses for rivets
12.	U.	Selection of rivets
13.	A.	Rivet metal
14.	A.	Weld nuts in tubing
15.	A.	Fasten handle with 1/4" bolt
16.	A.	Paint wood and metal

Name_____

Date_____

Grade_____

Evaluation Score Sheet:

	Item	Points Possible	Points Earned
1.	Correct overall dimensions	20	_____
2.	Sheet metal edges smooth, not sharp	10	_____
3.	Metal screwed to wood end	10	_____
4.	Handle bracket - bend and riveting	20	_____
5.	Nut welded in handle	10	_____
6.	Assembly and painting	20	_____
7.	Attitude and work habits	10	_____
	Total Points	100	_____

DEPARTMENT OF AGRICULTURAL ENGINEERING
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TAH 1586

COLD CHISEL

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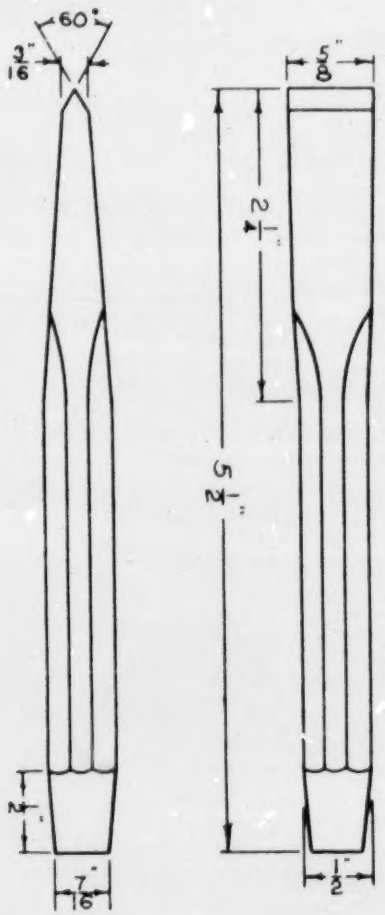

Construction Procedure:

1. Heat outer 2-1/4" of stock to a uniform cherry-red col
2. Place one side against anvil face. Using drawing blow work to shape rapidly starting at end and work back to 2-1/4" taper
3. Finish to 3/16" at tip and 5/8" width. Do not work a dull-red color
4. Anneal - heat to cherry-red and cool slowly (12-24 hou in lime or sand
5. File and polish forged faces - Do not grind
6. Temper with water: (Practice on old cold chisel)
   a. heat 2" to 3" of tip to uniform cherry-red color
   b. cool 3/4" to 1" until drops cling to tip when re- moved from water
   c. move tip to avoid cracks at water line
   d. quickly remove scale with steel brush or file
   e. observe color changes - quench lower 1/4" on purpl color. Color order is light straw, dark straw, br purple, dark blue and light blue
7. Grind cutting edge to 60° angle. U e tool gauge to ch angle
8. Chamfer end opposite point approximately 1/2" by 7/16" prevent mushrooming

(Ability to.....)
(Understanding of.....)

Construction Teaches:

1. U. Carbon content of tool steel
2. A. Determine carbon content by spark test
3. A. Forge cold chisel
4. U. Purpose of annealing metal
5. U. Purpose of hardening metal
6. A. Distinguish tempering colors and determine heat ra
7. U. Correct color for cooling metal to complete temper process
8. A. To temper metal
9. A. To grind cutting edge on grinder
10. A. To chamfer on grinder
11. U. Use of cold chisel on metal
12. A. To cut metal with the cold chisel

Bill of Material

1 - 1/2" x 5" octagon tool steel, .7 - .8 percent carbon content

Name_____

Date_____

Grade_____

Evaluation Score Sheet:

Item	Points Possible	Earn
1. Correct dimensions		
a. Chisel is 5-1/2" long	10	
b. True taper and correct length	10	
c. Chamfer dimensions and squareness	10	
d. Cutting edge is 5/8" x 3/16"	10	
e. Cutting edge ground to 60° - edges even and straight	15	
2. Tempering - tip correct hardness	25	
3. Overall appearance	10	
4. Attitude and work habits	10	
Total Points	100	

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DRAWBAR HITCH PIN

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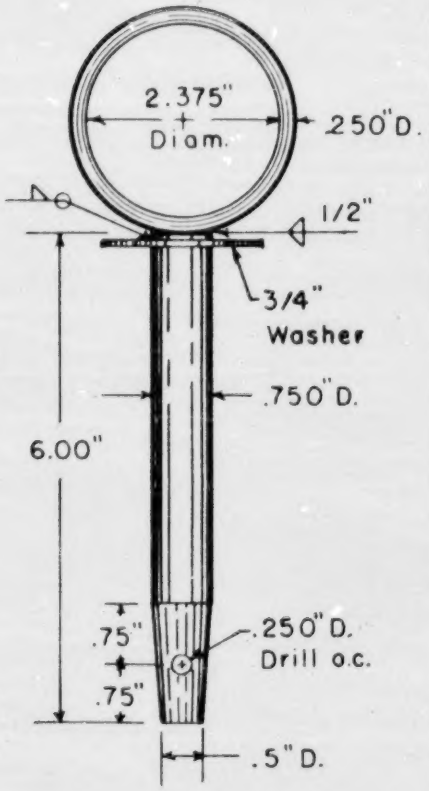

Bill of Material

1 - 1/4" x 8" M1020 hot rolled round
1 - 3/4" flat washer
1 - 3/4" x 6" round, C1042 cold rolled or C1045 hot rolled

Name: _____

Date: _____

Grade: _____

Construction Procedure:

1. Determine length of handle; I. D. + Thickness x 3. 14
2. Shape handle around 2" pipe, use vise as bending aid
3. Cut pin to length
4. Drill hole and shape end of pin
5. Weld washer to pin
6. Place handle on pin and weld
7. Remove slag and clean with steel brush

(Ability to .....
Construction teaches (Understanding of .....

1. U. Difference between low and medium carbon steel
2. U. Difference between hot and cold rolled steel
3. A. Determine length of handle
4. A. Measure distances
5. U. Correct hacksaw blade to select
6. A. Use the hacksaw
7. U. Need to center punch before drilling
8. A. Use center punch
9. U. Need to secure metal before drilling
10. A. Secure metal in drill vise
11. U. Need for correct drill speed
12. A. Adjust and use drill press
13. U. Correct grinding wheels and bolts
14. A. Adjust tool rests on grinders
15. A. Grind pin end
16. U. Correct electrode selection
17. A. Weld on handle and washer

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Length of pin	5	_____
2. Tapered area smooth	10	_____
3. Washer square to pin	10	_____
4. Washer spaced correctly	10	_____
5. Weld on washer	15	_____
6. Round handle	10	_____
7. Handle centered	10	_____
8. Weld on handle	15	_____
9. Hole centered	5	_____
10. Attitude and work habits	10	_____
Total Points		_____

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SAWHORSE

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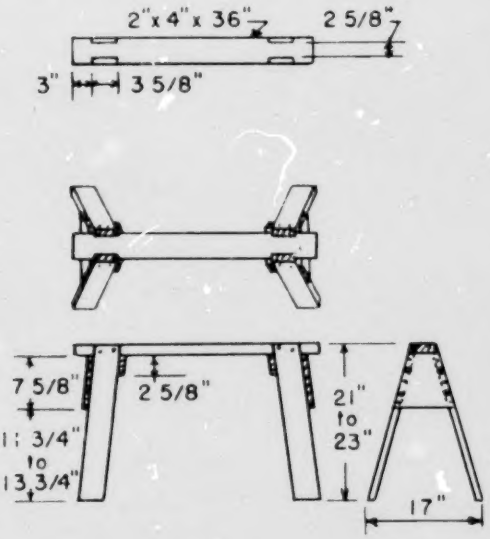

Construction Procedure:

1. Lay out legs and beam with framing square
2. Cut leg angles and notch beam
3. Assemble with scaffold nails
4. Brace legs to desired measurements using temporary braces
5. Cut permanent leg braces, tack in place
6. Pre-bore screw holes in legs and braces
7. Disassemble, apply glue to legs, joints and braces
8. Assemble with temporary braces
9. Check measurements with framing square
10. Insert screws, remove temporary braces
11. Wipe off excess glue, allow glue to set
12. Finish with plane or sandpaper and paint

Construction Teaches: (Ability to..... / Understanding of.....

1. U. Correct sawhorse height, spread of leg and beam end extension
2. U. Procedure to layout edge and side angles of the leg
3. U. Procedure to determine total length of leg
4. U. Procedure to layout cuts on beam and brace
5. A. Layout angles
6. A. Saw boards and chisel leg joints on beams
7. U. Different wood adhesives
8. U. The correct wood screws
9. A. Glue, assemble, screw and adjust to desire measurements
10. U. Proper preparation methods for painting
11. A. Select and apply paint

Evaluation Score Sheet:

Item	Points Possible	Points Earned
Dimensions - 20		
Sawhorse height	8	
Spread of legs	8	
Beam extension	4	
Angles - 28		
90° beam end to horizontal surface	6	
Centerline, equal spread of legs	6	
Bevel, bottom of legs	8	
All legs on floor	8	
Joint Preparation - 24		
4 leg joints	12	
2 outside braces	6	
2 inside braces	6	
Assembly and Finish - 28		
Screws, nails and glue properly used	10	
Finish	8	
Work habits and attitude	10	
Total points	100	

Name_____

Date_____ Grade_____

Bill of Material

1 - 2" x 4" x 3'0" Const. Douglas Fir
1 - 1" x 4" x 9'0" #2 White Pine
1 - 1" x 8" x 2'6" #2 White Pine
24 - 1-1/2" #9 Bright F.H. Screws
1 - Pint of paint, desired color
4 oz. of Resorcinol Resin or Casein Glue

Step-by-Step Layout Procedure:
Bul. 165, Sawhorse Layout with the Framing Square, HoBar Publications, 1305 Tiller Lane, St. Paul, Minnesota - 75c

Department of Agricultural Engineering
Iowa StateUniversity

DLA 1868

Wiring The Time Delay Relay

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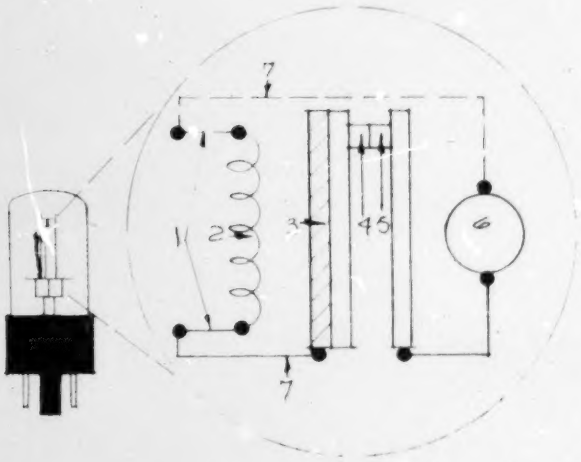

TIME DELAY RELAY

Part Identification:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Operational Procedure:

1. Complete the part identification section
2. Determining the type of relay
   A. List the code found on the relay
      _____ / _____ / _____
      a b c
   B. What does the code relate:
      a. _____
      b. _____
      c. _____
   C. Observe the contact points on the 115C15. Are they together or are th apart? _____
   D. Observe the contac points on the 115N015. Are they together or are t apart? _____
3. Wiring the 115C15 delay relay
   A. Connect using the diagram in the tim delay exercise. What is the maximum load that can be used directly with this relay? _____
   B. Energize the circuit. Does the bulb light immediately? _____
   C. Does the bulb come on or does it go off after the heater element gets warm? _____
   D. De-energize the circuit. Now energi the circuit, does the bulb come on immediately? _____
      Why? _____
4. List specific applications for both the NO and NC type relay _____

Operation Teaches: (Ability to . . .
(Understanding of . . .

1. A. Identify the parts of the time delay
2. U. The function of the various parts
3. U. The use of metals with different linear expansion
4. A. Properly wire a time delay relay
5. U. The various applications of the time delay relay
6. A. To determine the type of relay by observing the coding
7. A. Use safe work habits with electrical connections and wiring

Evaluation Score Sheet:

	Points Possible	Earned
1. Part Identification	28	
2. Operational Questions	22	
3. Correct Wiring Relay	25	
4. Observing Safety Proced.	15	
5. Attitude and Work Habits	10	
TOTAL	100	

Materials:
1-115N015 Time Delay Control
1-115C15 Time Delay Control
1-Light Bulb and Socket
3-Black Leads
2-White Leads

Job sheet prepared in cooperation with Allan Petersen.

NAME _____

DATE _____ GRADE _____

RAFTER LAYOUT
IOWA STATE UNIVERSITY
AGRICULTURAL ENGINEERING DEPARTMENT
GCM - 1968

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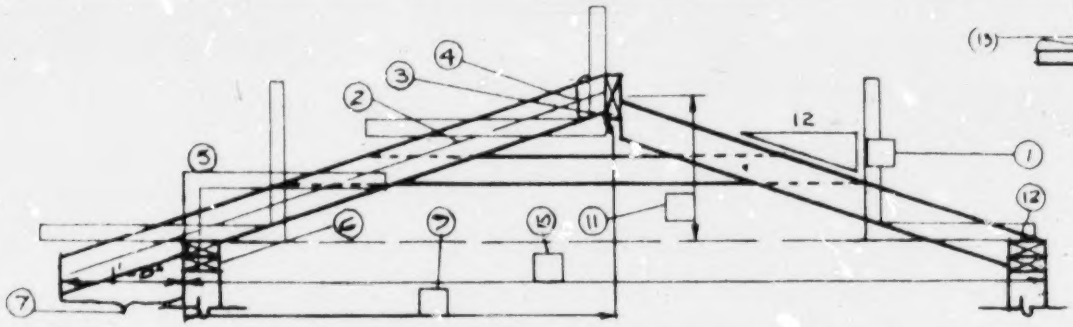


Rafter Layout Teaches: (Understanding of.....
Ability to .....

1. U..name building parts
2. A.. name parts of square
3. U..uses of framing square
4. A..to calculate pitch
5. A.. to layout rafter with step method
6. U..of common rafter tables
7. A..layout rafter using rafter tables
8. A..layout rafter with tail and w/o tail
9. A.. layout rafter with and w/o ridgeboard

Score Sheet:

1.	Identification	15 pts.____
2.	Pitch	15 pts.____
3.	Bottom page layout	10 pts.____
4.	Rafter layout on 2 x 4	15 pts.____
5.	Plumb cut	5 pts.____
6.	Seat cut	5 pts.____
7.	Tail	5 pts.____
8.	Length of rafter with	
	a. Shapleigh	10 pts.____
	b. Stanley	10 pts.____
9.	Exactness and work habits	10 pts.____
	Total Score	100 pts.

Materials Needed:

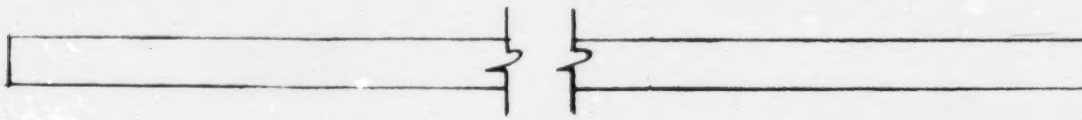
1. 2x3 scale framing square
2. Framing square
3. Shapleigh & Stanley rafter tables
4. Suitable lumber for layout

Identification:

1.	_____	9.	_____
2.	_____	10.	_____
3.	_____	11.	_____
4.	_____	12.	_____
5.	_____	13.	_____
6.	_____	14.	_____
7.	_____	15.	_____
8.	_____		

Layout Procedure:

1. Identify parts of building
2. Identify parts of framing
3. Calculate pitch _____
4. Layout rafter at bottom of step method No of Steps _____
5. Layout rafter w/o tail wit
   Shapleigh & Stanley tables
   Shapleigh length _____
   Stanley length/ft run _____
   Total length _____
6. Layout rafter with tail:
   Length of tail _____



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IOWA STATE UNIVERSITY
HEH - 2068

USE OF THE TORQUE WRENCH

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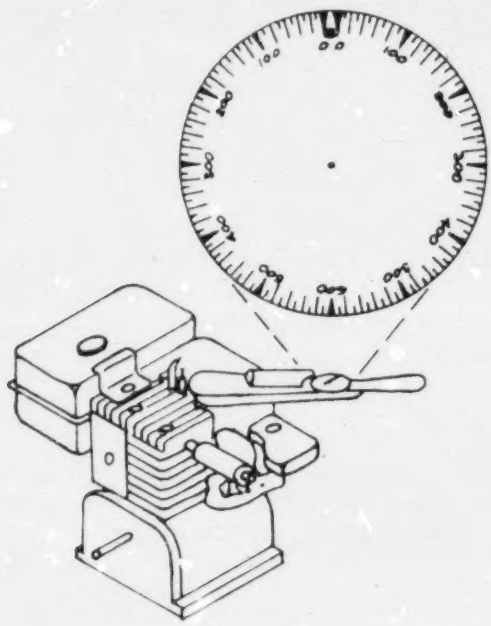

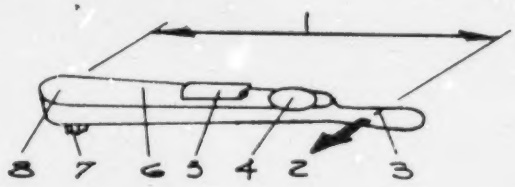

Identification:
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Operation Teaches: (Understanding of ...
(Ability to .....

1. U torque measurement
2. U run-down resistance
3. U set or seizure
4. A identify parts of torque wrench
5. A convert inch pounds to foot pounds
6. A select proper torque setting
7. A properly hold and use torque wrench

Operating Procedure:
1. Select torque setting
2. Convert readings as necessary
3. Set correct reading on wrench
4. Select correct socket
5. Measure run-down resistance
6. Add run-down resistance to torque setting
7. Set corrected reading on wrench
8. Correct for set or seizure
9. Torque bolt or plug to proper reading
10. Convert 960 inch pounds to foot pounds = _____ ft.#'s
11. Convert 30 foot pounds to inch pounds = _____ in.#'s

Score Sheet:

		Points Possible	Earned
1.	Identification	8	
2.	Selection of correct torque setting	15	
3.	Conversion of foot to inch pounds	15	
4.	Conversion of inch to foot pounds	15	
5.	Correct wrench setting	15	
6.	Proper torque on bolt or spark plug	25	
7.	Exactness and work habits	7	
	TOTAL	100	

Materials Needed:
1. Torque wrenches
2. Correct size sockets
3. Small gas engines or other equipment which requires torque measurement

NAME _____

DATE _____ SCORE _____

Department of Agricultural Engineering
Iowa State University
TAH 2169

Photoelectric Control

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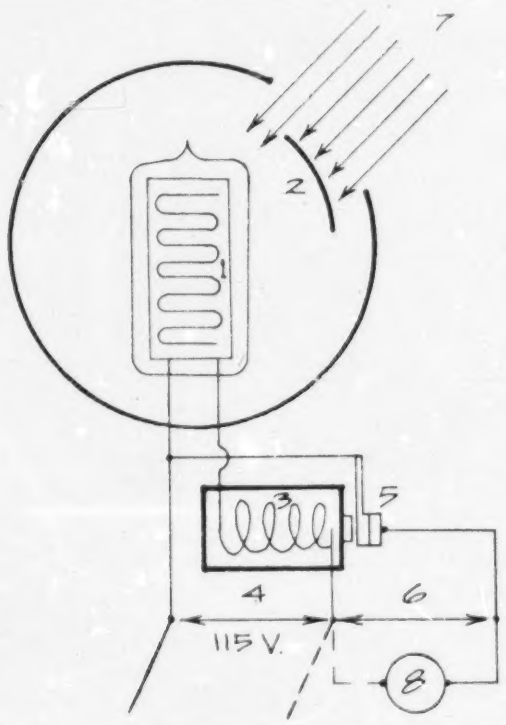

Part Identification:

1. _____ 5. _____
2. _____ 6. _____
3. _____ 7. _____
4. _____ 8. _____

Operation Teaches: 'Ability to .....
(Understanding of .....

1. A. Identify parts of photoelectric control
2. U. How a photoelectric cell operates
3. U. Applications of a photoelectric control
4. A. Correctly wire the control into a lighting circuit
5. A. Select proper control for specific application
6. A. Observe and use safe working habits with electrical wiring

Materials:

1 Photoelectric control mounted on board with connection leads
1 Light bulb and socket
2 White leads, No. 18 stranded
2 Black leads, No. 18 stranded

Operational Proccdure:

1. Complete the part identification
2. Specifications of control (Remove
   A. What is the voltage rating of control? _____volts.
   B. What is the maximum rating in this control? _____watts.
   C. Approximately how many 100 wa could this device control at without damage to it? _____
   D. What is the purpose of the lo the glass lens? _____
   E. Is the control switch in a NO position when not connected t source? _____
   F. Could this control be used to control a 1/2 h.p. motor? _____ why not? _____
3. Operation of control - Briefly de this control operates when connec power source and to a load as lig the photocell. _____
4. Wiring the control in a circuit.
   A. Connect using the diagram as
   B. Place the control in a well l Energize the circuit. Does t light? _____
   C. Cup your hand over the glass the bulb light or go off? _____
   D. If you desired the bulb to co dusk or early evening rather darkness, would you open or louver adjustment? _____
5. List specific application for thi _____

Evaluation Score Sheet:

		Possib
1.	Part Identification	21
2.	Control Spec. Questions	18
3.	Control Operation	11
4.	Correct wiring of control	25
5.	Observing Safety Proced.	15
6.	Attitude and Work Habits	10
	TOTAL	100

Name _____

Date _____ Grade _____

AGRICULTURAL ENGINEERING DEPARTMENT
IOWA STATE UNIVERSITY
HEH 2269
MAKING QUALITY WELDS

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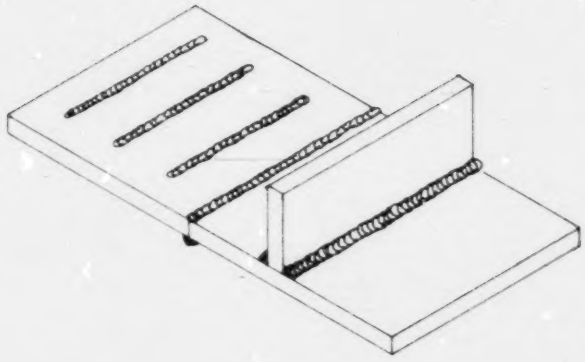
Welding Exercise

3 beads
2 butt welds
2 fillet welds

Note: Welds may be turned in separately for grading or may be fabricated into project as shown.



Operation Teaches: (Ability to .....
(Understanding of .....

1. U..Types of welds
2. U..Types of joints
3. U..Types of electrodes
4. U..Effects of distortion
5. A..Select correct electrode
6. A..Select correct amperage
7. A..Correctly prepare joint edges
8. A..Control distortion
9. A..Make quality beads
10. A..Make quality butt welds
11. A..Make quality fillet welds
12. A..Safely operate arc welders

Materials:
2 - 4"x4"x¼" Steel plates
1 - 2"x4"x¼" Steel plate
E6011, E6013, or E7018 Electrodes

Evaluation Score Sheet:

		Points Possible	Earned
1.	Three beads	30	
2.	Two butt welds	20	
3.	Two fillet welds	20	
4.	Freedom from spatter	5	
5.	Freedom from distortion	5	
6.	Exercise-Electrode Sel.	15	
7.	Work habits-attitude	5	
	Total	100	

Date_____ Grade_____

A. Steps in Selection of Materials and Procedures in Welding
   1. Examine base metal
      Type of metal, carbon content, thickness, type of weld, type of joint, appearance desired, strength needed, position of the weld.
   2. Select correct electrode
      Electrode number, electrode size
   3. Select correct amperage
   4. Select correct joint preparation
      Cleaning, veeing, clamping
   5. Select correct safety equipment
      Safety glasses, halmet with No. 10 eye shield, leather gauntlet gloves, hard finish clothing.

B. Steps in Making the Weld
   1. Strike the arc - Scratch or tap method
   2. Pre-heat - Hold long arc until molten pool is desired size.
   3. Lay the bead - (a) Electrode angle -- 15° from vertical in direction of travel; (b) Arc length - 1/16" to 1/8" makes frying sound; (c) Speed of travel - watch width (2 X electrode dia.), height and shape of molten pool.
   4. Fill the Crater: E6013 - shorten the arc, reverse direction, pull out from rear of pool; E6011 - raise electrode slowly

Electrode Selection -- Common Farm Electrodes
1. E6011
2. E6013
3. E7018
4. ENi
5. Hardsurfacing
6. Special Electrodes
   a. ESt
   b. Cutrode
   c. Chamfertrode

Exercise--Electrode Selection
Given the following situations, select the correct electrode-

Situation	Electrode	Size	Amps.
Thinner metals -(1/8")			
Good appearance desired			
Poor fit of joint			
Thicker metals (3/8")			
Dirty and rusty metals			
Deep penetration desired			
Medium carbon steels (¼")			
High quality bead desired			
High strength desired			

Name_____

DEPARTMENT OF AGRICULTURAL ENGINEERING
IOWA STATE UNIVERSITY
JP 2369

TOOL SHARPENING GAGE

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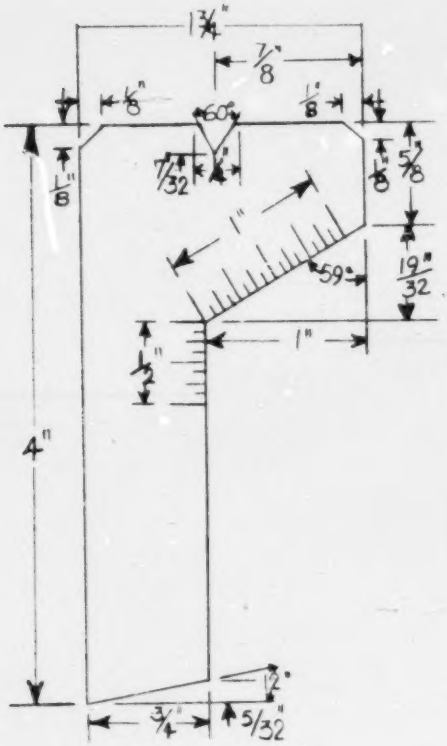

Construction procedure:

1. Square one corner of aluminum or brass stoc
2. Measure and scribe outline on stock with aw
3. Mark graduations with awl.
4. Cut out tool gage with hacksaw. (Use prote tive blocks on each side when cutting in vi
5. Dress to the lines with file, bevel corners
6. Use corner file to cut chisel vee.
7. Polish with steel wool.
8. Submit to instructor for evaluation.

Construction teaches: (Ability to . . .
(Understanding of . . .

1. U. Selection of the correct material
2. U. Selection of the correct hacksaw blade
3. U. Selection of the correct files
4. U. Correct methods of finishing and polishing stock
5. A. Measure and transfer outline of gage to stock
6. A. Scribe outline on metal with awl
7. A. To calibrate and indicate rule marks on metal
8. A. To correctly use the hacksaw
9. A. To correctly use the metal file
10. A. To do draw filing
11. A. To cut a vee with a taper file
12. A. To finish flat stock

Gage can be used to measure:

1. Cold chisel cutting angle
2. Twist drill, cutting edge angle and length
3. Twist drill, lip clearance

Bill of material:

1-7/8" x 4-1/16" x 3/32" aluminum or brass (aluminum is easier to work)

NAME: _____

DATE: _____

GRADE: _____

Evaluation score sheet:

Item	Points Possible	Earn
1. Length of gage	10	
2. Width of narrow end	10	
3. Width of wide end	10	
4. Vee position for cold chisel angle	10	
5. Angle for drill cutting edge	15	
6. Accuracy of the 1" and 1/2" rules	10	
7. Angle for drill lip clearance	10	
8. Correct angle and size of bevel corners	5	
9. Finish	10	
10. Attitude and work habits	10	
	100	

Total Points _____

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IOWA STATE UNIVERSITY
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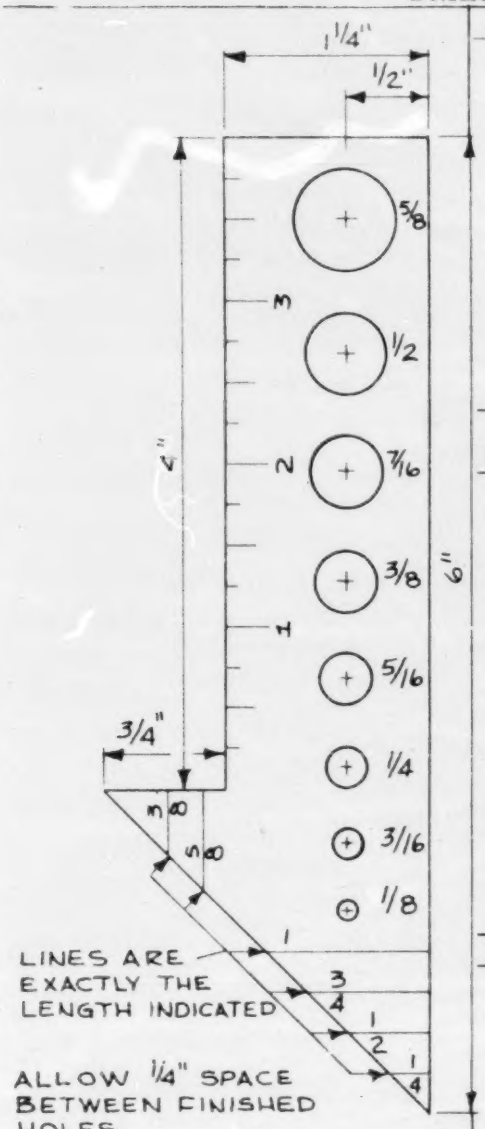
DRILL BIT, BOLT AND WASHER GAUGE



Bill of Material

1 - 2 1/4 x 6 1/4 - 3/32" stainless steel, mild steel, brass or 1/8" aluminum

Name: _____

Date: _____

Grade: _____

Construction Procedure:

1. Measure and scribe outline on stock.
2. Cut out with hacksaw.
3. Use flat file to file all edges.
4. Measure out and center punch for holes.
5. Select bit, position and drill holes.
6. Measure and scribe lines for inside diameter gauges.
7. Cut marks with cold chisel.
8. Measure and scribe 4" rule in 1/4" graduations.
9. Cut marks with cold chisel or other sharp tool.
10. Polish surfaces.
11. Mark in numbers identifying size of gauges and rule. Use engraving, metal stamp set, or paint on numbers.

Construction Teaches: (Ability to . . . . . (Understanding of . . . . . .

1. U. Selection of flat stock.
2. A. Read plans, measure and scribe.
3. A. Use awl.
4. U. Hacksaw blade selection.
5. A. Use hacksaw.
6. U. Correct file selection and operation.
7. A. File correctly.
8. U. Need for center punching and securing metal for drill
9. A. Selection of proper bit sizes.
10. A. Adjust and operate drill press.
11. A. Measure and scribe gauge and rule marks.
12. U. Correct method of finishing and polishing stock.
13. A. Use abrasive wheel and emery cloth for finishing.
14. A. Use engraving tool, metal stamps, or fine painting techniques.

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Length of right side	5	
2. Length of left side and lip	10	
3. Angle of bottom	5	
4. Width of top	5	
5. Correct placement of holes	15	
6. Accuracy of inside of diameter gauge marks	15	
7. Accuracy of rule marks	15	
8. Number identification	10	
9. Finish	5	
10. Attitude and work habits	15	
Total Points		

Gauge Applications:

1. Drill bit size. (series of holes) Used to determine the size of a bit or bolt.
2. Inside diameter (points on bottom and left side). To measure inside diameter of hole to determine size of bolt and size of given washer.
3. Bolt length (graduated rule on left). To determine length of bolt required, a given bolt, and the threads on a given bo

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TAH 2569

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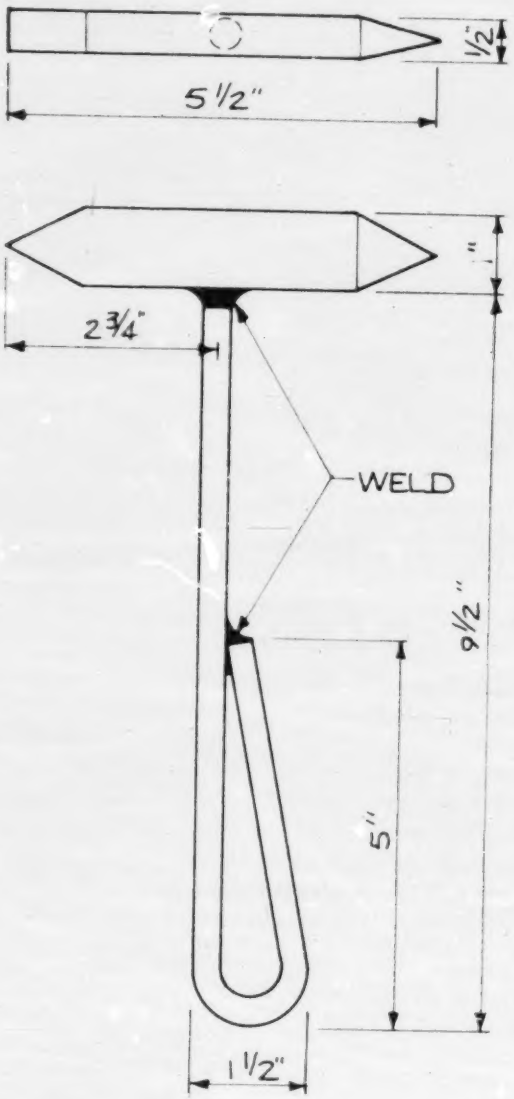
CHIPPING HAMMER



Bill of Material

1 - 1/2" x 1" x 5 1/2" M.S.
1 - 3/8" x 15" H.R. round M.S.
(an old chisel or punch could be used for the head)

Name _____

Date: _____ Grade: _____

Construction Procedure:

1. Cut head with oxyacetylene torch
2. Grind head to shape
3. Cut round stock to length and bend handle
4. Fusion weld or braze handle
5. Hardsurface head ends with oxyacetylene torch
6. Reshape head ends

Construction teaches (Ability to ..... (Understanding of .....

1. A. To read dimensions
2. A. To layout a project
3. U. Oxyacetylene cutting principles
4. A. To cut metal with oxyacetylene torch
5. A. To bend handle to shape
6. U. Fusion welding or brazing
7. A. Fusion weld or braze
8. U. Hardsurfacing principles
9. A. Apply hardsurfacing with the oxyacetylene torch
10. U. Grinder wheels, belts and files
11. A. Shape ends of head

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Length of head	10	
2. Length of handle	10	
3. Shape of handle	10	
4. Taper on head ends	10	
5. Brazing or welds	20	
6. Hardsurfacing	20	
7. Overall appearance	10	
8. Attitude and work habits	10	
Total Points		

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IOWA STATE UNIVERSITY
TAH 2669

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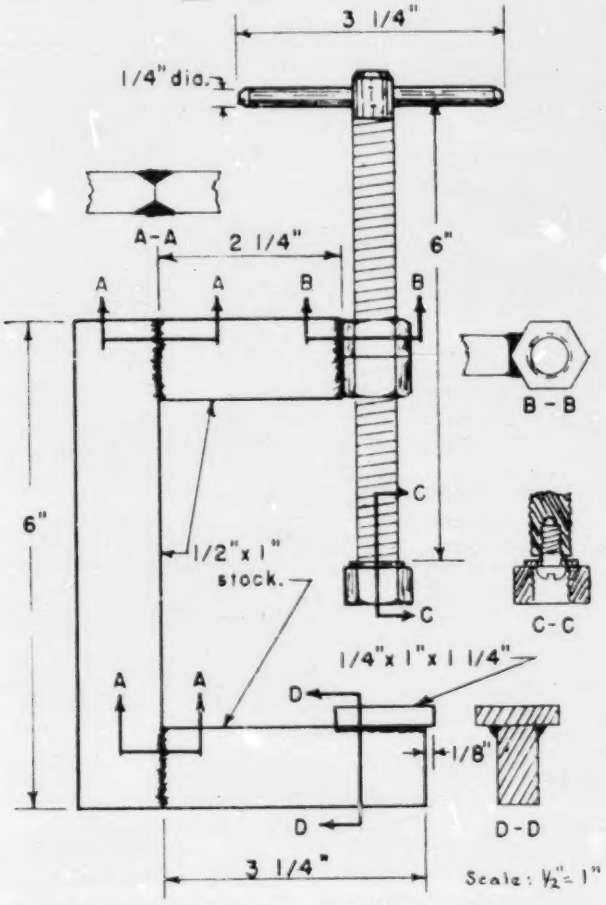
WELDED "C" CLAMP



Bill of Material

1 - 1/2" x 1" x 6" H. R. mild steel
1 - 1/2" x 1" x 2 1/4" H. R. mild steel
1 - 1/2" x 1" x 3 1/4" H. R. mild steel
1 - 1/4" x 1" x 1 1/4" H. R. mild steel
1 - 1/4" x 3 1/4" C. R. round
1 - 1/2" x 7" rod
3 - 1/2" nuts
1 - 3/8" washer
1 - #12 x 1/2" machine screw

Construction Teaches	(Ability to . . . . .) (Understanding of . . . . .)
1. A.	Measure distances accurately
2. U.	Selection of hacksaw blades
3. U.	Selection of files; tap & die set
4. A.	Use of hacksaw and files
5. A.	Use of grinders; tap & die set
6. U.	Need for center punching
7. A.	Use the center punch
8. U.	Need for securing metal in drill vise
9. A.	Use the drill press
10. U.	Correct electrode selection
11. A.	Arc weld
12. U.	Brazing procedure
13. A.	Braze mild steel
14. U.	Size of pilot hole for tap
15. U.	Controlling distortion when welding
16. A.	Read plan and symbols

Construction Procedure:

1. Measure and cut all materials
2. Thread 1/2" bolt, run on two nuts
3. Center bolt end
4. Drill pilot hole and tap for #12 x 1/2" m. screw
5. Place washer on bolt, braze bolt into threads
6. Braze nut to washer
7. C. punch, bore handle hole for snug fit
8. Install handle, weld if necessary
9. Bevel metal at sections AA
10. Arc weld at AA, BB and DD
11. Clean welds, prepare for grading

Evaluation Score Sheet:

Item	Points Possible	Earned
1. Measurements of frame	20	
2. Welds, arc	15	
3. Brazing	5	
4. Centering of handle	5	
5. Nut attachment to bolt	5	
6. Squareness	20	
7. Quality of threads	10	
8. Work habits	20	
	100	

Name _____

Date _____ Grade _____

DEPARTMENT OF AGRICULTURAL ENGINEERING
IOWA STATE UNIVERSITY
TAH 2771

THE ELECTRIC MOTOR NAMEPLATE

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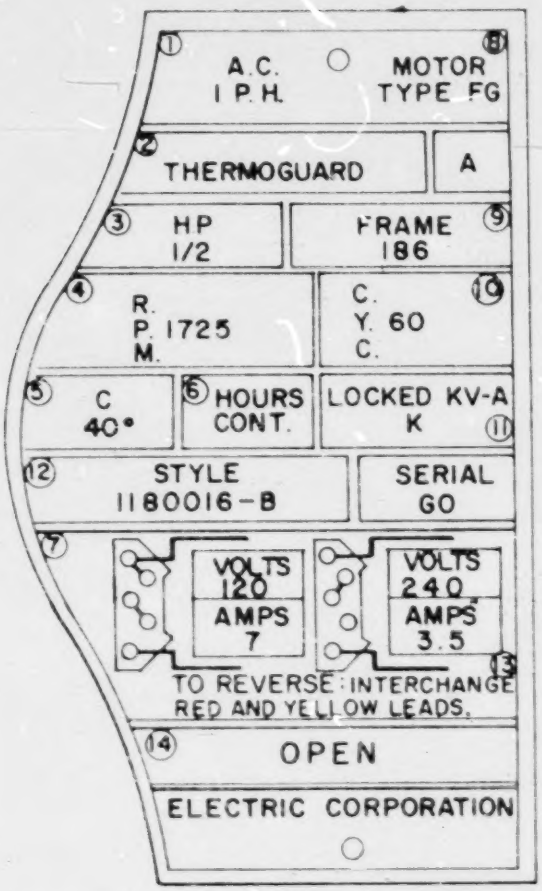

Material: One electric motor with nameplate for each two students.

Operation Teaches: (Ability to...
(Understanding of...

1. A. Identify the motor nameplate.
2. A. Identify where the specific terms are listed on the nameplate.
3. U. The terms listed on the motor nameplate. (For example; volts, amps, locked rotor amps, cycle, phase, service factor, rpm, hp, temp. rise, motor type, frame no., and serial no.
4. A. Identify types of electric motors.

Skill sheet developed by Lee Stence and edited by Thomas A. Hoerner.

Name _____

Date _____ Grade _____

Part Identification:

1. _____ 8. _____
2. _____ 9. _____
3. _____ 10. _____
4. _____ 11. _____
5. _____ 12. _____
6. _____ 13. _____
7. _____ 14. _____

Operational Procedure:

1. Complete the part identification section.
2. What other phase might be found on the motor na plate? _____
3. If this motor did not have a built-in overload tection device, what size and type fuse should used for protection on 120 volts?
   Type _____ Size _____
4. How would a motor having 50°C rise differ from this motor? _____
5. What would a service factor of 1.25 indicate on an electric motor? _____
6. What other cycles per second might be found on electric motors? _____
7. Using the below formula, what is the locked ro amperage for this motor on 120 volts? _____

$$\text{Locked KVA} = \frac{1000 \times \text{HP} \times \text{KVA/HP}}{1.00 \times \text{Volts}}$$

   KVA/HP for various codes are:
   J = 7.1-8.0, K = 8.0-9.0 & L = 9.0-10.0
8. Compute the wattage for this electric motor on 120 volts _____ watts, on 240 volts _____ watt
9. What other types of enclosures are commonly fo on electric motors? _____
10. Collect the following data from an electric mo your home farm or one provided by your instruc

Type_____	Frame_____
HP_____	Locked KVA code_____
Cycle_____	Temperature rise_____
Volts_____	RPM_____
Amperage_____	Duty cycle_____
Service factor_____	Type enclosure_____
Thermal Protection____	Type bearings_____

Evaluation Score Sheet:

Item	Points Possible	Points Earn
Part Identification (2 pts/item)	28	
Operational Questions (3 pts/item)	30	
Information from Motor	30	
Attitude and Work Habits	12	
Total	100	

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TAH 2871

ADJUSTABLE SAFETY JACK

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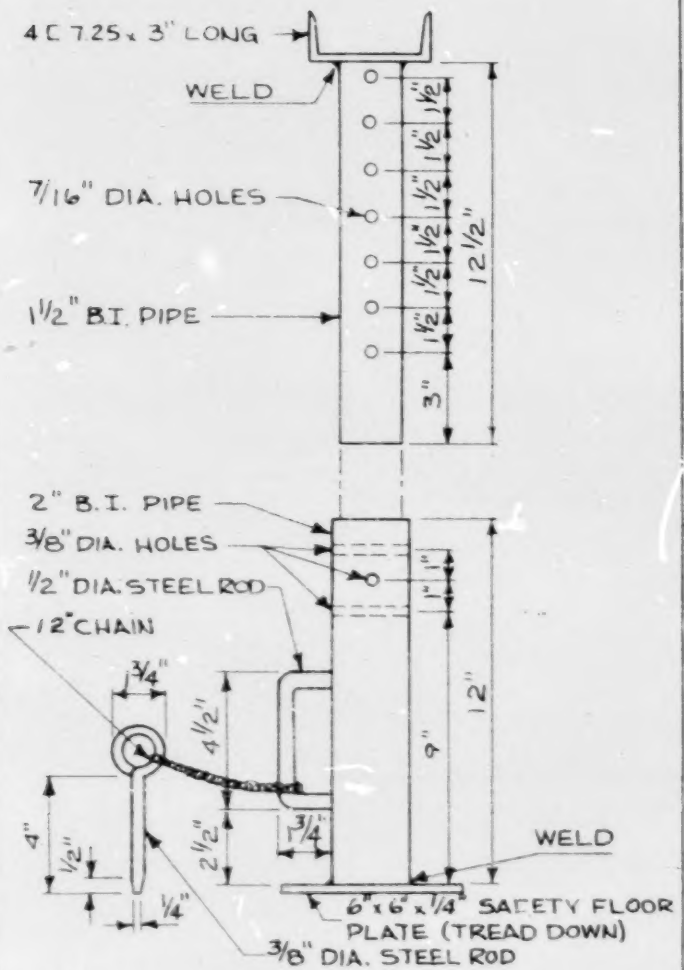

Bill of Material:

1 - 1/4" x 6" x 6" safety plate for base
1 - 2" x 12" standard black iron pipe, 2.375" O.D.
1 - 1-1/2" x 12-1/2" standard black pipe, 1.90" O.D.
1 - 3" structural channel 4" depth, .18" web thickness, 1.580" flange
1 - 1/2" x 8" mild steel rod for handle
1 - 3/8" x 8" mild steel rod for pin
1 - 12" chain
1 pint desired color primer and paint

Name: _____

Date: _____ Grade: _____

Construction Procedure:

1. Measure and cut metal to dimensions
2. Heat 3/8" rod in forge. Use hammer and anvil to form a 1" I.D. eye. Grind end to taper
3. Form 1/2" handle as shown with 4-1/2" spread
4. Drill 3,3/8" holes in 2" pipe at 9", 10", and 11". Make 10" hole perpendicular to others
5. Drill 6, 7/16" holes in 1-1/2" pipe at 1-1/2" intervals. Start 3" from the bottom
6. Weld handle to 2" pipe as shown
7. Weld channel and safety plate to pipes as shown. (You may use standard pattern for non-skid feature)
8. Chip welds, grind rough edges, clean metal, and paint desired color
9. Attach chain and pin to handle

Construction Teaches: (Ability to .....
(Understanding of .....

1. U. Selection of pipe, channel iron, steel plate and chain types
2. A. Measure and transfer plan to stock
3. A. Use forge, hammer and anvil to shape rod
4. A. Use grinder
5. A. Drill holes in pipe and correct use of drill press
6. U. The selection of hacksaw blades
7. A. Use hacksaw correctly
8. U. Correct electrode selection
9. A. Weld parts together
10. A. Clean metal for painting
11. U. Proper paint selection
12. A. Paint and care for paint brushes

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Base metal cut square	10	
2. Holes centered and to dimension	15	
3. Eye pin formed to dimension	15	
4. Pipes, plate and channel at 90 degree angle	10	
5. Weld appearance, penetration	20	
6. Painting	10	
7. Overall appearance	10	
8. Attitude and work habits	10	
Total Points	100	

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FUNNEL

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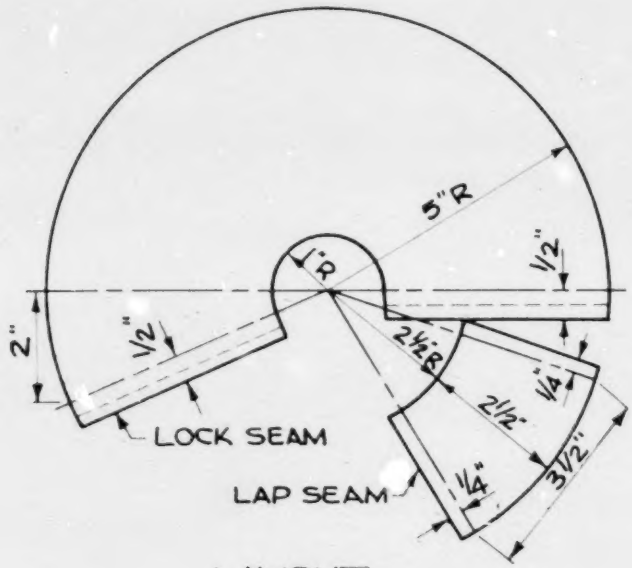
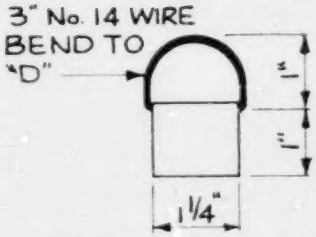


LAYOUT



DETAIL OF LOOP

NOTE: CUT ON SOLID LINES, FOLD ON DOTTED LINES, & LAP TO BROKEN LINES.

Bill of Material

1 pc - 10" x 12" No. 26 or 28 gauge galvanized metal

1 pc - No. 14 steel wire, 3" long (optional)

Name: _____

Date: _____

Grade: _____

Construction Procedures:

1. Lay out pattern for body and spout on stiff paper or on the sheet metal. Allo 1/2" for a lock joint seam, and 1/4" for lap joint on the spout
2. Trace pattern on sheet metal with scribes or dividers, cut out with tin snips, aviation snips or electric shear
3. Fold edges of the body in opposite directions to form a lock joint
4. Hook folded edges together and set wit hand groover to make a tight seam
5. Form spout over a stake, and solder the lap joint
6. Peen a small flange on large end of spout and drop it into the body
7. Solder the spout in place. Inside and out
8. Solder the seam of the body
9. Form a ring with the wire and fasten to the upper edge of the body
10. Remove flux and dress rough edges fo grading

(Ability to .....

Construction Teaches: (Understanding of ..

1. U. Difference between tin and galvanize sheet metal.
2. U. Difference in gauge or size of stock.
3. A. To figure diameter of circle when given the circumference or vice vers
4. A. Measure and trace pattern on the stock.
5. A. Use dividers to scribe outline on metal.
6. A. Use the tin snips, aviation snips, or electric shears.
7. U. Selection of correct solder and flux.
8. A. Solder galvanized sheet metal.
9. A. To make lock seams and use the hand groover.

Evaluation Score Sheet:

	Points Possible	Earn
1. Correct Measurements	10	
2. Lock seam	10	
3. Lap seam	10	
4. Soldering	30	
5. Top, round	10	
6. Spout, round	10	
7. Overall appearance	10	
8. Attitude & work habits	10	
Total Points		

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HEH 3071

CASE HARDENING OF MILD STEEL

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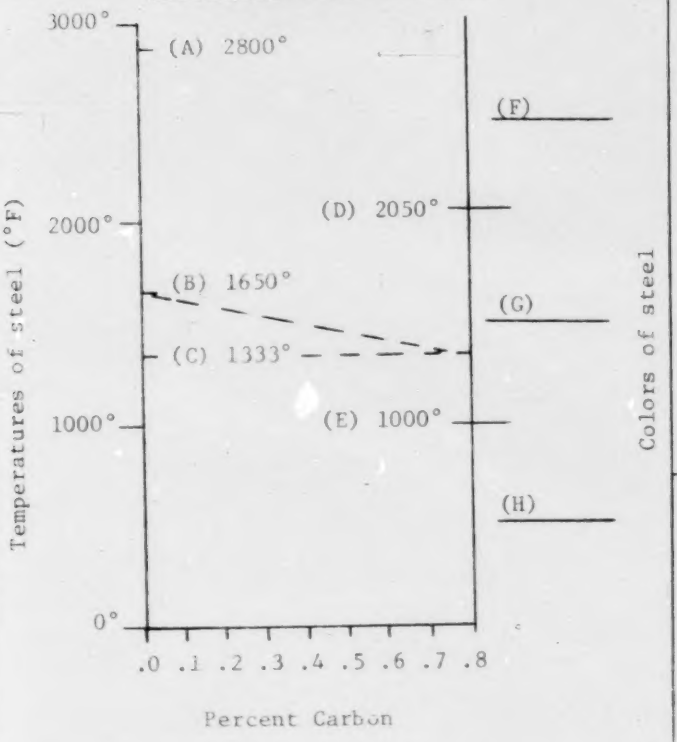
Steel Temperature Diagram



Identification of parts of diagram

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

Case Hardening Procedure

1. Clean the stock to be hardened
2. Place carburizing compound in flat metal pan
3. Heat stock with oxy-acetylene torch to 1650°F (bright red)
4. Submerge stock in carburizing compound until a fused shell is formed on stock
5. Re-heat stock to 1650°F
6. Quench stock in water using a scrubbing motion
7. Spark test surface of stock to check carbon content
8. Use file to check surface for hardness

Operation Teaches: (A = Ability to...
(U = Understanding of...

1. U. Properties of case hardened steel
2. A. Use oxy-acetylene torch for heating
3. A. Identify steel temperatures by color
4. A. Add carbon to surface of steel using carburizing compound
5. A. Harden carbon steel by quenching
6. A. Identify carbon content of steel by spark testing
7. A. Identify hardness of steel by the use of a file

Materials:

Mild steel stock
Kasenit No. 1, Surface-hardening compound, Iowa Machinery & Supply, 1711 2nd Avenue, Des Moines, Ia.
Oxy-acetylene torch with heating tip
Flat metal tray
Container of cold water
Metal Tongs
Safety glasses and gloves

Evaluation Score Sheet

Item	Points Possible	Points Earned
Identification (5 each)	40	_____
Carbon content of surface	20	_____
Hardness of surface	20	_____
Evidence of clean stock	10	_____
Safety and work habits	10	_____
Total	100	_____

Name _____

Date _____ Grade _____

DEPARTMENT OF AGRICULTURAL ENGINEERING
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OXY-ACETYLENE WELDING EQUIPMENT

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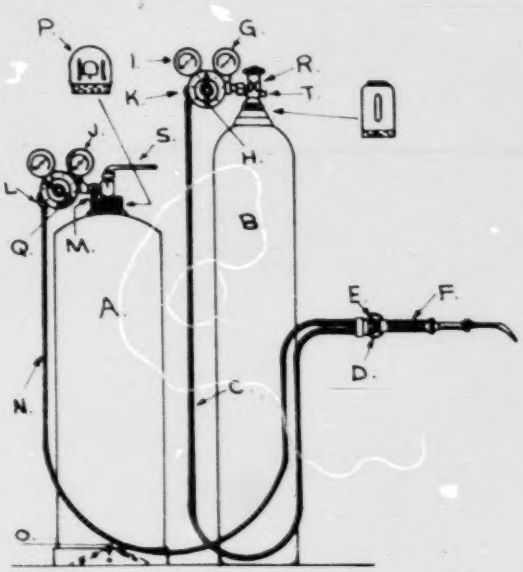

A. _____ K. _____
B. _____ L. _____
C. _____ M. _____
D. _____ N. _____
E. _____ O. _____
F. _____ P. _____
G. _____ Q. _____
H. _____ R. _____
I. _____ S. _____
J. _____ T. _____

Materials: One portable oxy-acetylene welding unit.

Operation Teaches: (Ability to...
(Understanding of...

1. A. Identify parts of oxy-acetylene welding outfit.
2. U. Function of each part of oxy-acetylene welding outfit.
3. A. Properly install, adjust, and use each part of oxy-acetylene system.
4. U. Safety precautions connected with oxy-acetylene equipment.

Evaluation Score Sheet:

	Points Possible	Earned
1. Part Identification (1 pt/item)	20	
2. Operational Questions (2 pts/item)	40	
3. Equipment Set Up Procedure	20	
4. Safety Procedures Followed	10	
5. Attitude and Work Habits	10	
Total	100	

Skill sheet developed by Dean Ludwick and edited by Thomas A. Hoerner.

Operational Procedure:

1. Complete the part identification section.
2. Answer the following questions:
   a. What is the capacity in cubic feet of the common oxygen cylinder? _____ cu.ft. Of the common (no. 4) acetylene cylinder? _____ cu.ft.
   b. What is the full cylinder pressure in psi at 70°F of the oxygen cylinder? _____ psi
   Of the acetylene cylinder? _____ psi
   c. On which gages (by letter in the picture) can the cylinder pressure be read for oxygen _____, for acetylene _____.
   d. What is the letter of the gages indicating the line or working pressure for oxygen _____, for acetylene _____.
   e. List the pressure range on the high pressure gages for oxygen _____ to _____, for acetylene _____ to _____.
   f. What is the pressure range on the working pressure gage for oxygen _____ to _____, for acetylene _____ to _____.
   g. What is the common color of hoses and equipment for oxygen _____, for acetylene _____
   h. List the type of threads for equipment and connections for oxygen _____, for acetylene _____.
   i. What is the maximum working pressure for safe operation for acetylene? _____ psi
   j. Describe the purpose of the fusible plugs and bursting disc on the cylinders. _____
   _____
   k. Describe the recommended method for checking for leaks. _____
   _____
3. On the back of this sheet list the complete procedure for set up and connection of the oxy-acetylene welding unit.

Name: _____

Date: _____ Grade _____

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BRAZE WELDING MILD STEEL
BUTT WELD

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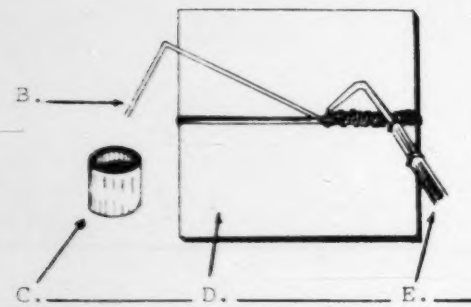
DIRECTION OF TRAVEL

A.



Materials:

Oxy-acetylene welding unit.
Braze welding rod, bare or flux coated, 1/8" diameter.
Braze welding flux if using bare rod.
Two - 2" x 4" x 1/16" to 1/8" steel plates.

Evaluation Score Sheet:

Item	Points Possible	Points Earned
1. Mechanically cleaning of metal.	10	
2. Proper selection of rod and flux.	10	
3. Use of equipment, pressures and flame	10	
4. Chemically cleaning of base metal.	10	
5. Manipulation of braze welding rod and blowpipe tip.	10	
6. Uniformity of weld.	20	
7. Strength of weld.	10	
8. Appearance of weld.	10	
9. Safe work habits and attitudes.	10	
Total	100	

Operational Procedure:

1. Complete part identification & direction of travel arrow on drawing.
2. Select base metal to be used--1/16" to 1/8" th and 2" x 4".
3. Mechanically clean metal 1/4" to 1/2" on edges to be butted together.
4. Select braze welding rod, either bare or flux coated, 1/8" in diameter.
5. If bare rod used, select correct powdered braz welding flux.
6. Position pieces of mild steel; make sure they fit tightly together.
7. Using a neutral flame, (O-5#, A-5#) preheat ba metal to cherry red, approximately 1600°F.
8. Chemically clean metal by applying brazing flu with rod to area where braze welding rod is to adhere. Keep temperature of base metal at 160
9. Tin surface of weld by applying a thin coating braze welding rod. Use forehand technique as shown in drawing. Manipulate rod and flame so that base metal melts rod. Overheating rod wi cause zinc to be burned away.
10. Keep temperature of base metal at approximatel 1600°F. Complete weld by manipulating braze welding rod and flame back and forth as the we is moved down the metal surfaces. Build up we to approximately 1/16" thick and 1/2" wide.
11. Allow weld to cool slowly.
12. Clean excess flux from weld by buffing or chis
13. Test weld by placing in vise to edge of weld. Bend to 90° angle, away from bottom or back of weld. Weld should not break away from base me
14. Submit completed weld for instructor evaluatio

Operation Teaches: (Ability to.....
(Understanding of...

1. U. The braze welding process.
2. A. Select braze welding rod and flux.
3. A. Safely operate oxy-acetylene unit.
4. A. Use forehand method of oxy-acetylene weldin
5. A. Select proper flame.
6. A. To chemically clean base metal.
7. A. To tin base metal.
8. A To manipulate blowpipe tip and braze weldin rod in building up weld.

Name: _____

Date: _____ Grade _____

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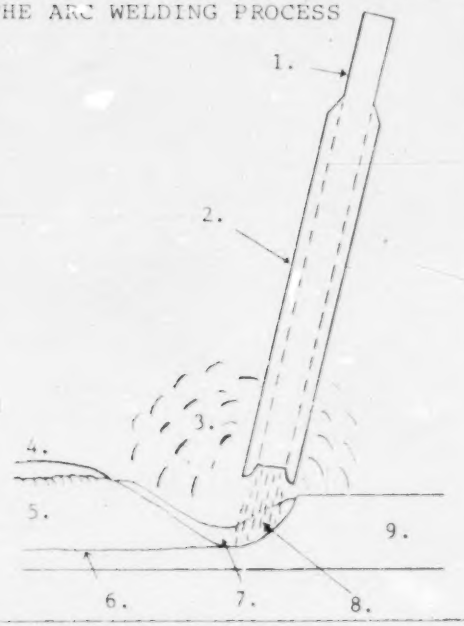
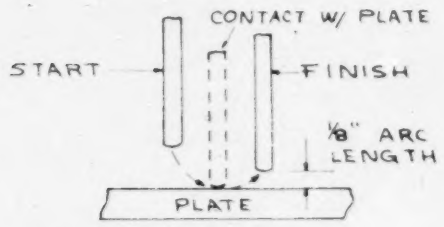
THE ARC WELDING MOLTEN POOL

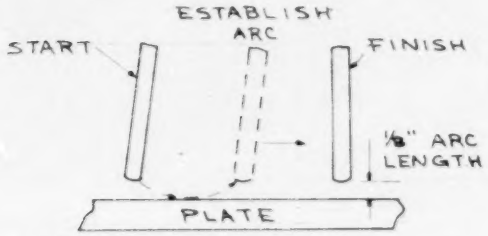
THE ARC WELDING PROCESS



STRIKING THE ARC



A. _____



B. _____

Materials Needed:

E6011 or E6013 electrodes
1 piece of 1/4" mild steel, 2" x 4"

Name: _____

Date: _____ Grade: _____

Part Identification:

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____

Operational Procedure:

1. Complete the part identification of the welding process illustrated to the left
2. Study the two methods of striking the a
3. Identify the two methods illustrated.
4. Which method is probably the easiest fo beginner? _____
5. Which method is recommended when weldin AC machine? _____
6. Explain why a long arc should be held m when beginning a weld? _____
7. Shortening the arc length causes the am (increase - decrease).
8. List the 4 characteristics that most in the quality of an arc weld.
   a. _____
   b. _____
   c. _____
   d. _____
9. Establishing the molten pool:
   a. Select an E6011 or E6013 electrode a of mild steel 1/4" thick and 2" x 4"
   b. Select an arc welding machine and se amperage at 100-115 amps.
   c. Dress safely and properly for arc we
   d. Using the two methods of striking th establish the molten pool and comple short arc welded beads 1/2" to 1" in following the characteristics discus item 8.
   e. Clean slag from welds and evaluate b quality of molten pool.
10. Complete 3 beads 1 1/2" to 2" in length the techniques and methods of striking discussed. Submit beads for evaluation

Evaluation Score Sheet:

Item	Possib
1. Part Identification (2 pts)	18
2. Methods of striking the arc	5
3. Questions 4-8 (1 pt)	8
4. Quality of molten pools	25
5. Arc beads	
a. Uniformity	10
b. Speed of travel	8
c. Length of arc	8
d. Proper amperage	8
6. Safe working habits	10
Total	100